LIBRARY OF CONGRESS NOV 1 1907 LAW DIV.

The JOURNAL OF ELECTRICITY POWER AND GAS

WITH WHICH IS INCORPORATED
The Engineers', Architects' and Builders' News

PUBLISHED WEEKLY

By the Technical Publishing Company, Atlas Building, 604 Mission Street, San Francisco Cal.
Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879.

Vol. XIX. No. 17 San Francisco, Cal., October 26, 1907. Yearly subscription $2.50. Single copies 10 cents. Back numbers prior to current month 25 cents.

INSULATORS

The most perfect glass insulator made is the HEMINGRAY TEAT INSULATOR.

The Teats on the lower rim of the petticoat attract the water on the outer and inner surfaces of the insulator into drops. The water drops from these points on to the cross arm, thereby preventing the moisture from creeping to the pin.

A Complete Stock Carried

Electric Appliance Company
726-728-730 Mission Street
San Francisco

STANDARD UNDERGROUND CABLE CO.

MANUFACTURERS OF
BARE AND INSULATED WIRES AND CABLES

CHICAGO NEW YORK PITTSBURG BOSTON PHILADELPHIA ST. LOUIS ATLANTA SAN FRANCISCO

Pacific Coast Dept., A. B. Saurman Manager, Shreve Bldg., San Francisco, Cal.

SUB. OFFICE—LOS ANGELES, CAL.

OKONITE WIRE

The Standard for Rubber Insulation

Okonite Tape, Manson Tape,
Candee Weather-proof Wire,
Candee (Patented) Potheads.

THE OKONITE COMPANY, 253 BROADWAY, N. Y.

INDIANA RUBBER AND INSULATED WIRE CO.

MANUFACTURERS OF
PARANITE AND PEERLESS RUBBER COVERED WIRES AND CABLES

Underground, Aerial, Submarine and Inside Use
TELEPHONE, TELEGRAPH AND FIRE ALARM CABLES
All Wires are Tested at Factory JONESBORO, IND.

Electric Appliance Company
728 Mission St., San Francisco — Pacific Coast Agents

California Incandescent Lamp Co.

Have Reopened at

No. 56 and 60 NATOMA ST.

SAN FRANCISCO

Bristol's Recorders

For Every Electric Light
Railway, Power and Gas Plant Compel
Safe and Efficient Operation
Send for Catalogue A. V.
The Bristol Co., Waterbury, Conn.
N. Y., 114 Liberty St. Chicago, 753 Monadnock Block

The National Conduit & Cable Co.

Manufacturers of
TROLLEY WIRE
BARE COPPER WIRE AND CABLES
WEATHER-PROOF WIRES AND CABLES
PAPER-INSULATED CABLES
FOR TELEPHONE, TELEGRAPH AND POWER
703 MONADNOCK BUILDING, SAN FRANCISCO
C. H. PENNOYER, PACIFIC COAST MANAGER

VULCAN

Refrigerating and Ice Making Machinery
Manufactured by
VULCAN IRON WORKS
OFFICE: 702 ATLAS BLD'G. 604 MISSION STREET WORKS: FRANCISCO AND KEARNY STS.
San Francisco, California.

PACIFIC METER CO.

MANUFACTURERS OF
WET AND DRY GAS METERS, STATION METERS, PROVERS, GAUGES, ETC.
617 MONADNOCK BUILDING. SAN FRANCISCO, CAL.

VAN EMON ELEVATOR CO.

MANUFACTURERS OF .... HIGH-GRADE ELEVATORS

R. J. DAVIS, President
B. C. VAN EMON, Vice-President and Manager
H. B. RATHBONE, Secretary and Treasurer

NOT IN THE ELEVATOR TRUST

DIRECTORS
LOUIS F. MONTRAGLE W. P. PLUMMER
GEO. M. PINCKARD R. S. MUNKINS

OFFICE AND CONSTRUCTION DEPARTMENT
52 - 54 NATOMA STREET, SAN FRANCISCO

FACTORY AND FOUNDRY
WEST BERKELEY, CAL. (32,000 sq. ft.)

We Are Moving This Month

Write Us

For Special Prices on Apparatus

"It's not what you pay—but what you get"

Let us supply your electrical wants
Prices and catalogs for the asking

Standard Electrical Works

Electric Machinery and Supplies

Ware Houses—40 and 60 Natoma Sales Rooms and Offices—119-121 New Montgomery

San Francisco

- HIGHEST QUALITY -
FOR ALL PURPOSES

CHAPMAN
.:VALVES:.

CHAPMAN VALVE MFG. CO.
INDIAN ORCHARD, MASS.

CHAS. C. MOORE & CO. INC., PACIFIC COAST REPRESENTATIVES

SIMPLEX

RUBBER INSULATED
WIRES
AND
CABLES

Aerial Submarine
Flameproof
Lead Covered Steel Taped

PROMPT ATTENTION TO SPECIAL REQUIREMENTS

THE SIMPLEX ELECTRICAL CO.
110 STATE STREET, BOSTON.

STANDARD ELECTRICAL WORKS
AGENTS
NO. 56 AND 60 NATOMA ST. SAN FRANCISCO

THE

Journal of Electricity, Power and Gas

WITH WHICH IS INCORPORATED

The Engineers', Architects' and Builders' News

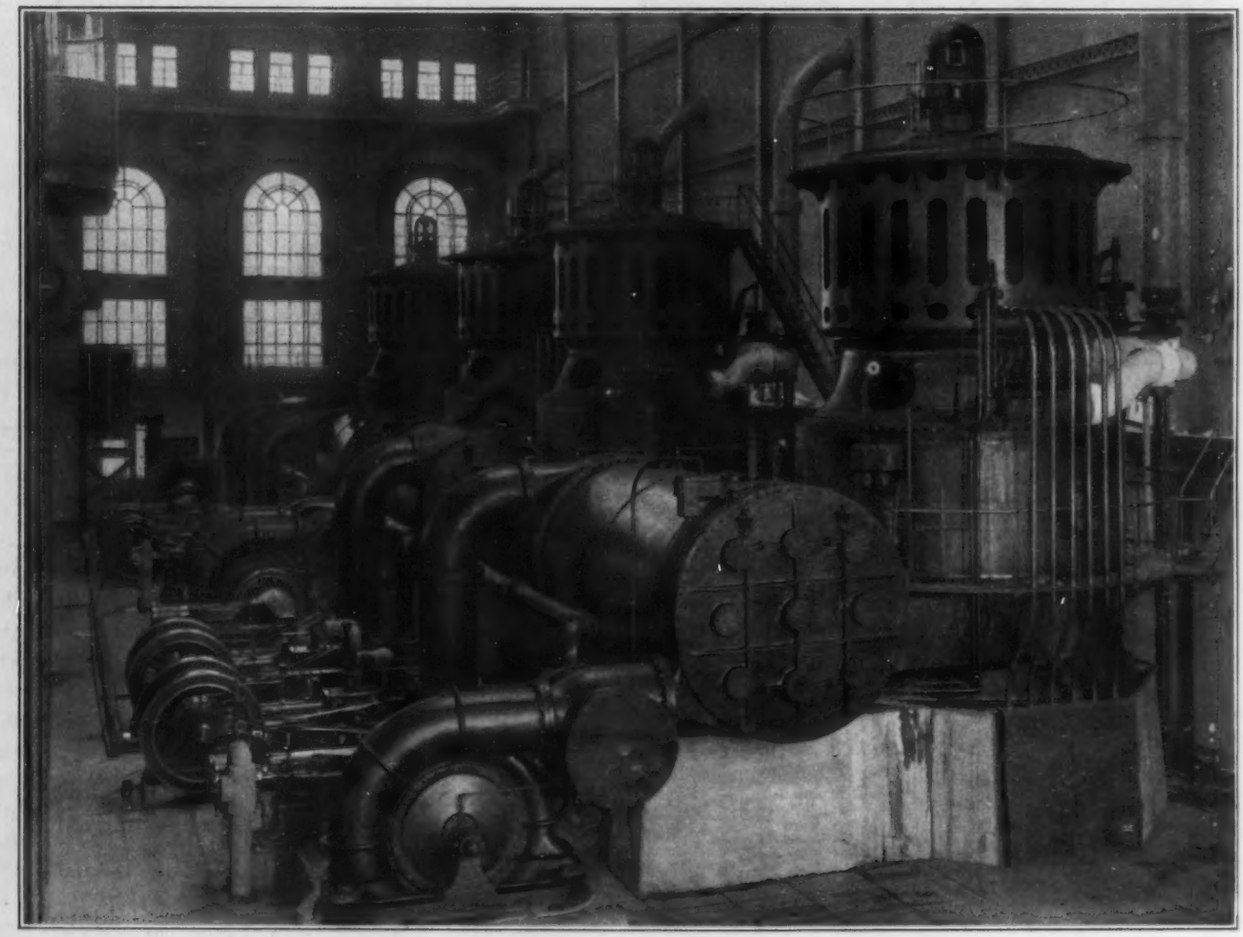
VOLUME XIX. SAN FRANCISCO, CAL., OCTOBER 26, 1907 No. 17

MODERN EUROPEAN AND AMERICAN STEAM TURBINES.

(Concluded.)

The advance in steam turbine construction during the past decade has been truly wonderful and the installation of turbine units from 5000 kilowatts capacity up to a maximum output of 10,000 horsepower shows the utmost confidence of leading European as well as American power engineers.

In electrifying the New York Central Railway a large number of sub-stations will be required as well as several power plants. For supplying electric current to the feeders of the eastern section of this New York State Railway two power stations have been completed, one located at Yonkers, N. Y., and the other at Port Morris on Long Island Sound.



POWER HOUSE AT PORT MORRIS

The new stations of the New York Central Railroad at Port Morris, as well as other large railway power plants equipped with steam turbine units exclusively, show the tendency of the times in favor of this new form of prime mover. It may be of interest to note the arrangement of one of these modern American steam turbine plants, not only as to the installation of the steam turbines alone, but also the auxiliary equipment, the boiler plant and the switchboard and substation apparatus. The Port Morris steam turbine plant certainly exemplifies the latest American construction.

The Yonkers power house has recently been placed in operation and will supply current to the New York end of the electrified New York Central Railway, the Yonkers plant also supplying power to the line along the Hudson River formerly operated exclusively by steam locomotives, but shortly the trains are to be handled by powerful electric engines.

The boiler room, steam turbine and generator room and switchboard gallery in the Port Morris plant, shown in the accompanying views, give a fair idea of the electrical equip-

ment installed in both stations.

The boiler plant and turbine and generator installation are in the same building but divided by a brick wall along the length of the building which is constructed of steel and brick on concrete foundations.

The boiler installation includes at the present time sixteen of the twenty-four Babcock & Wilcox boilers ultimately to be utilized in this plant, which will have a total heating surface of 150,000 square feet, each boiler having a grate area of over 100 square feet and a heating surface of over 6000 square feet. Superheaters are provided for each boiler, raising the temperature of the steam to 200° F. above the temperature due to the pressure by means of over 1200 square feet of superheating surface. These boilers will have a total

ELECTRIC REMOTE CONTROL SWITCHBOARD AT POST MORRIS POWER HOUSE

capacity of 15,000 horsepower, or over 600 horsepower per boiler operating at a maximum steam pressure of 200 pounds per square inch.

The coal bunkers surround the boiler room and the present equipment of sixteen boilers are arranged in two rows of eight each on either side of a central aisle, the boilers being fed with bituminous coal to Roney stokers, while the ash is delivered to hoppers below the boilers and the wash-out water is carried away from out board drains at the rear of the settings, while the products of combustion are carried away by two radial brick stacks 250 feet high and a trifle less than sixteen feet in internal diameter.

The superheated steam is conducted through the brick wall to the present installation of four Curtiss steam turbines in pairs by fourteen-inch loops so arranged that four boilers supply the superheated steam to one turbine, and each turbine is connected with the boiler supply in such a manner that steam may be taken from either of the two banks or sets of four boilers, while the auxiliary apparatus is connected between the adjacent turbines with the cross-connecting bands and thereby supplied with the necessary steam.

Gearing and shafting has been installed with a hand wheel in the boiler room operating the main cut-off valve of the turbine, and a free exhaust pipe has been connected to each turbine separate from the exhaust of the auxiliary apparatus, which includes three pressure pumps, a large steam pump supplying each of the two accumulators, and a Worthington condenser having a cooling surface of 17,000 square feet for each turbine, together with Worthington air pumps and centrifugal pumps for the water circulation.

A part of the pumps are operated by electric motors of ten horsepower each, such as the two stage turbine hot well pump, while steam engines of the Fleming side crank type, noted at the left in the illustration Fig. 1, are employed for driving the centrifugal circulating water pump.

The four turbo-alternaters of the vertical type shown in the accompanying illustration Fig. 1, each have a capacity of 5000 kilowatts and were constructed by the General Electric Company. These Curtiss turbines are of the five-stage type directly coupled to vertical revolving field alternators supplying a polyphase current at 11,000 volts pressure and a frequency of twenty-five periods per second.

These electrical generators are capable of standing an overload for short periods equal to their normal capacity and for several hours an overload equal to half the capacity of the generators, while an efficiency of 90 per cent is obtained with an output of only 1250 kilowatts and 96 per cent with an output of 5000 kilowatts or full load.

For supplying the necessary exciting current to the revolving fields a motor generator set is employed together with two steam turbine direct-current generator units, the former consisting of a 200-horsepower motor taking a current from the alternating current service at 200 volts and a frequency of twenty-five cycles and directly driving a direct-current machine delivering 1200 amperes at 125 volts at a speed of 500 revolutions per minute. The latter two exciter units are of 150 kilowatts each and consist of two horizontal steam turbines of the non-condensing type operating with a steam pressure of 200 pounds and delivering and exciting current of 125 volts pressure and supplying 1200 amperes from each dynamo. A storage battery equipment has also been installed which will deliver 1200 ampere hours at a one-hour discharge rate, seventy-four elements being utilized in this accumulator plant, equipped with two end cell switches. The current from this battery is not only employed in connection with the exciter sets for supplying direct current to the turbo-alternator fields but is also utilized for driving the direct-current motors operating the auxiliary apparatus, such as the pump and other mechanism, also supplying the necessary current for arc and incandescent lamps about the station.

A portion of the switchboard gallery is shown in the accompanying illustration, Fig. 2, mounted in a glass-enclosed structure shown at the left upper corner of the illustration, Fig. 2, of the turbine and generator room. The remote control switchboard is installed in this gallery, separate boards being provided for controlling the exciter while the operating bench board is located in the center.

The high tension switching equipment is installed in a separate building from the main power plant. In this switch house basement are installed the cables and instrument transformers as well as the high-tension connections. The switch house is 100 feet long and about 50 feet wide, provided with fireproof compartment for the high-tension apparatus of the turbo-alternator. The oil switches are mounted on the first floor of this building and there is an auxiliary operating board as well as instrument panels for each pair of groups. The General Electric H. type of oil switches is employed with knife switches located in the lower part of the switch casing for disconnecting from the high-tension service, these oil switches have a capacity of 500 amperes and the tie switches 1200 amperes.

There are two transformers of 200 kilowatts each supplying a three-phase current of 200 volts for lighting and power service in the switch house and turbo-alternator room. Alternating current motors of about 250-horsepower capacity are utilized for driving auxiliary motors in this station and direct-current motors of 180 horsepower.

The current from the Port Morris station is conducted by overhead as well as underground power transmission lines to eight sub-stations, only a part of which have been connected by aluminum cables mounted on steel poles. These steel poles are mounted in concrete foundations, and are provided with pine cross arms which carry the No. 0000 aluminum cables about three feet apart. The same size cables of the three-conductor type are utilized for the underground transmission line, paper insulation and lead sheathing being utilized, the cables being laid in ducts of vitrified tile. These conduit ducts are covered with waterproofing and laid in concrete.

The current is conducted by these transmission circuits to the various substations where the pressure is reduced by step-down transformers and the three-phase current changed to a proper current of lower voltage and conducted through feeders to the railway collector conductors after passing through the necessary transforming apparatus in the substations.

THE NECESSITY OF GOOD WRITING FOR THE ENGINEER.

In an address by J. L. Harrington before the Technological Society of Kansas City, he states that technical men are peculiarly prone to offend in the use of their mother tongue, because they have not, as a rule, read deeply in classical literature or been instructed thoroughly in the construction of the language. Their higher education is generally almost entirely technical. Yet the character of the technical man's language is important in his social and business intercourse; in his business and professional correspondence; in the promulgation of orders, rules and regulations for the guidance of those under his direction; in the preparation of specifications, contracts and reports; in writing and delivering addresses and technical papers, and in writing technical books for the advancement of his profession. A technical man is, presumably, an educated man, and if he does not speak and write like one, suspicion is cast upon the entire range of his learning. When a man cannot spell correctly, or use ordinarily good grammar, it is difficult to convince others that he is professionally able. There are many vocations in which it is not essential that a man be cultured and intelligent; but the technical professions are not among them. Nothing so surely makes a man's secret habits of thought, his real character, as the little tricks of speech which are exhibited when his mind is on the matter, rather than the manner of his speech.

In business correspondence the value of good usage is still more manifest than in conversation, since the written word is permanent, and correspondence greatly extends the field of one's intercourse. A letter often passes through many hands and multiplies the good or bad impressions it produces. If its import is not clear, it may cause disagreement or involve serious financial disadvantage. Even bad punctuation will often seriously alter the entire meaning of a sentence, and bad grammar in particular at once stamps a writer as being something of an ignoramus. The art of letter writing, like a knowledge of grammar, is commonly considered to be within the range of everyone; but anyone who has had large experience in business correspondence knows that few men write good letters. It is so rare to find a matter which is composed of more than one or two items, clearly, concisely and thoroughly discussed in a letter that favorable attention is immediately attracted to its writer. Not a few men owe the opportunity for advancement to their ability to write a good letter.

The detrimental results of bad English in conversation or in correspondence are by no means as great as in formal technical articles. Every normal, healthy-minded technical man desires to leave a permanent record of the results of his best thought and work to aid his co-workers and those that come after him. An ably written description of work performed, discoveries made or methods developed accomplishes more for the advancement of science than many well designed and well executed works. In the preparation of articles for the technical press and papers for the learned societies, there is time to study form and style and to eliminate errors due to haste; hence, when such matters are ill written, it is not unfairly argued that the writer is ignorant of the correct use of the language. Such an opinion is exceedingly detrimental to the writer. It weakens his arguments, causes him to be misunderstood, or so detracts from the interest of his readers that the matter is not read. The idea that a technical paper is dry at best, and that the English employed in it is of small consequence, has long been proved incorrect. Certain of the better magazines print only carefully selected matter, and reject everything but scholarly, well written articles. Their influence upon the language is quite as good as that of the better books of the day; but the well written article costs more money than the "pot-boiler," hence the magazine is more expensive, its circulation is limited, and it influences a smaller number of readers than its cheap and less worthy competitor. Yet there is so much nowadays that is well written that no busy professional man is willing to spare the extra time and effort necessary to read and digest an ill written paper.

The style should be crisp and clear. An elegant, showy style is often a sign of lack of breeding. Short words of English origin are invariably stronger and more rugged than their longer and more elegant synonyms which are derived from the Latin or Greek; hence their use is nearly always to be preferred. Simplicity and force demand simple, direct language. The style should be so smooth and so unostentatious that the hearer's attention is not drawn to the language, but is left entirely free to follow the course of the thought.

SOME CALIFORNIA POWER STATIONS.

The following is a partial list of the power stations, numbering 106, now deriving "energy" from California streams, and the horsepower of each, as compiled by the California Promotion Committee. Among the important new plants at present under construction, and not enumerated in the list, are the Pacific Power Company's Station No. 2, in the Northern Sacramento Valley, 15,000 horsepower; and the immense undertaking of the Western Power Company, on the Feather River. While the power expected from this project is unstated, it is known that the plant will be one of the most formidable in the United States. There are many other plants omitted from the list, being as yet still under construction.

	Electric Horsepower
Yuba Electric Power Co., Marysville	2,000
Development Syndicate, Butte County	183
South Yuba Water Co., Newcastle	134
Santa Ysabel Mining Co., Jamestown	80
Nevada County Electric Power Co., Nevada City	1,600
Tuolumne Electric Light & Power Co., Jamestown	500
Oroville Gas & Electric Co., Oroville	75
Spring Creek Electric Power Co., Shasta	300
Boca Ice Co., Prosser, Placer Co.	140
Big Dipper Mining Co., Iowa Hill	120
Gold Bluff Mining Co., Downieville	125
Pioneer Mining Co., Plymouth	125
Hidden Treasure Gold Min. Co., Placer Co.	200
Jumper Mining Co., Stent	400
Mountain Copper Mining Co.	400
Blue Lakes Water Co., Blue Lakes	2,000
Ventura Land & Power Co.	125
Griffith Con. Mining Co., El Dorado Co.	500
Central California Electric Co., Auburn	750
Bell Electric Co., Auburn	100
Redlands Electric Power Co., Redlands, 4th Station	400
Rawhide Mining Co.	1,800
Four Hills Mining Co., Plumas County	300
City of Healdsburg Electric Light Co., Healdsburg	200
Utica Mining Co., Angels	1,100
Weaver Mining Co., Ballarat	100
Butte County Elec. Power & Light Co.	9,500
Central California Electric Co., 2d Station	1,200
Truckee River General Electric Co., Floriston	2,300
Sierra Power Co., Southern California	1,100
Crystal Lake Gold Mining Co.	450
Stanislaus Power Co., Calaveras County	1,400
Montauk Consolidated Gold Mining Co.	100
United Electric, Gas & Power Co.	100
Santa Ysabel Mining Co., Tuolumne Co.	260
Keswick Electric Power Co., Shasta Co.	4,500
Big Creek Power Co., Santa Cruz, 2d Station	1,500
Folsom Electric Power Co., Folsom	4,000
Nevada County Electric Power Co.	1,000
Santa Ysabel Mine, Tuolumne Co.	500
Tuolumne County Electric Co.	500
Gold Valley Mining & Milling Co.	250
Big Creek Electric Power Co., Santa Cruz	800
Redlands Electric Power Co., Redlands	1,000
San Antonio Electric Power Co.	800
Standard Con. Mining Co., Bodie	650
Mammoth Mine, Madera Co.	175
Mt. Lowe Railway Co., Altadena	200
South Yuba Canal Co., Newcastle	130
Central California Electric Co., Newcastle	1,200
Bell Electric Light Co., Auburn	100
Banner Mining Co., Butte County	160
Weaverville Electric Light & Power Co.	700
Calumet Mining Co., Shasta Co.	300
Delmatia Mining Co., El Dorado County	230
Southern California Power Co., Santa Ana Canyon	5,000
San Gabriel Electric Co.	3,200
Tuolumne County Water Co.	1,500
Big Creek Power Co.	900
Utica Gold Mining Co.	1,000
Mariposa Commercial & Mining Co.	730
Oroville Electric Light & Power Co.	300
Los Gatos Ice & Power Co.	150
Yosemite Valley Lighting Plant	250
Eagle-Shawmut Mining Co.	100
Bay Counties Power Co.	2,100
Standard Electric Co.	1,800
Bishop Light & Power Co.	100
Bay Counties Power Co., 2d Station	1,400
Standard Electric Co., 2d Station	3,000
Bay Counties Power Co., 3d Station	1,400
Edison Electric Co.	1,000
Hazel Gold Mining Co.	300
Northern California Power Co., 2d Station	6,600
American River Electric Co.	6,600
Cloverdale Light & Power Co.	350
Siskiyou Electric Power Co.	1,100
Gaston Gold Mining Co.	260
Edison Electric Co., 7th Station	1,700
North Mountain Power Co.	1,100
Los Gatos Ice & Power Co., 2d Station	150
Nevada Power M. & M. Co.	3,000
Redlands Electric Power Co., 2d Station	800
San Joaquin Power Co., Fresno	1,400
Power Development Co., Bakersfield	1,500
Mount Whitney Power Co.	1,800
Colgate No. 1	5,000
Ontario Power Co.	1,500
Little Bear River Co., Alta	1,350
Standard Electric Co., Electra	13,500
Edison Elec. Light Co., Los Angeles, Six Sta.:	
Kern River	25,000
Santa Ana No. 1	4,000
Santa Ana No. 2	1,600
Mill Creek No. 1	400
Mill Creek No. 2	1,400
Mill Creek No. 3	5,200
Pacific Gas & Electric Co., Ten Stations:	
Electra (Mokelumne River)	26,000
Colgate (North Fork Yuba River)	12,000
De Sabla (Butte Creek)	18,000
Centerville (Butte Creek)	1,200
Folsom (American River)	5,000
Auburn (Middle Fork American River)	670
Newcastle (Mid. Fork American River)	1,000
Alta (South Fork Yuba River)	4,000
Rome (South Fork Yuba River)	1,760
Yuba (North Fork Yuba River)	880

TESTS OF INTERNAL-COMBUSTION ENGINES ON ALCOHOL FUEL.*

By Charles Edward Lucke and G. M. Woodward.

In Europe during the last ten years the high price of the petroleum oils used as fuel in internal-combustion engines has led to extended efforts to find other suitable and economical fuels. Among these alcohol has received much attention, and there have been manufactured and used in Germany a considerable number of engines especially designed for this fuel. Recently in this country a widespread interest has developed in the possibilities of alcohol as a fuel. The question of a possible substitute for the petroleum fuels will become of increasing importance as time goes on. The supply of crude oil to be obtained in the United States must ultimately diminish, and the history of the past indicates that a constant increase in price of kerosene and gasoline may reasonably be expected. On the other hand, it is not unreasonable to hope that with improvements in agriculture and in process of manufacture the cost of alcohol may fall, so that as regards cost alcohol may occupy a position of constantly increasing advantage in comparison with the petroleum oils.

The tests described in this report were all made in New York City, chiefly in the mechanical engineering laboratories of Columbia University, between October 1, 1906, and February 1, 1907.

The objects of this investigation may be put under two heads:

First, to determine whether the gasoline and kerosene engines at present on the American market can run on alcohol as fuel. This involved as related matters the determination of the manipulation to be followed in making the engines run on alcohol, the measurement of the relative maximum powers of the engines when using alcohol and the fuels for which they were originally made, and lastly the relative consumptions of the different fuels.

Second, to determine so far as the limited time and means available permitted, the improvements which might be desirable in the design of engines manufactured especially for alcohol.

The details of the different tests are given later in the bulletin. The following is a summary of the extent, scope, variety and number of the tests carried out on the various engines used. The results of 192 consumption tests are reported for the eight different engines which were run on alcohol. These tests are all numbered consecutively. Many more tests were made, but the results are not printed because they give little additional information. In addition, a great many additional observations of speed, power, etc., were recorded for the different engines with different conditions of adjustment, under which time was not used for a measurement of fuel consumption.

Each of the eight engines was run on alcohol as well as on the gasoline or kerosene for which it was designed. The engines used were:

No. 1. A 15-horsepower, 2 cylinder, vertical, 4-cycle gasoline engine.

No. 2. A 6-horse-power, horizontal, 4-cycle gasoline engine.

No. 3. A 6-horsepower, horizontal, 4-cycle gasoline engine.

No. 4. A 6-horsepower, vertical, 4-cycle gasoline engine.

No. 5. A 6-horsepower, horizontal, 2-cycle kerosene engine.

No. 6. A 40-horsepower, 4-cylinder automobile gasoline engine.

No. 7. A 40-horsepower, 4-cylinder automobile gasoline engine.

No. 8. A 2-horsepower, vertical, 2-cycle marine gasoline engine.

*Condensed from Bulletin 191, U. S. Department of Agriculture.

Properties of Liquid Fuels.

It must be remembered that all the liquid fuels available for commercial use are complicated mixtures of many different chemical substances, and hence are always liable to more or less change in their chemical composition, and accordingly in their properties.

Gasoline and kerosene are most easily examined by their specific gravities, but since each is a mixture of numerous lighter and heavier oils, a definite constant density is not a guarantee that the composition may not change sufficiently to affect the action of the fuel in an engine.

Commercially pure grain or ethyl alcohol is sensibly pure except for the water which may be mixed with it. In this country alcohol is described according to its strength by stating the percentage of absolutely pure alcohol, by volume, which exist in the mixture of alcohol and water. Thus, 90 per cent alcohol means that if the alcohol present could be separated absolutely pure, its volume would be 90 per cent of the volume of the actual mixture of alcohol and water. Since alcohol is lighter than water, the stronger the alcohol the lighter the specific gravity, and 90 per cent alcohol contains less than 90 per cent of alcohol by weight. Moreover, since when pure alcohol and water are mixed, the volume of the mixture is less than the sum of the volumes of the water and alcohol before mixing, 90 per cent alcohol contains more than 10 per cent of water by volume.

In the statistics relating to alcohol, issued by the United States Commissioner of Internal Revenue, quantities are stated in "proof" gallons. A proof gallon contains 50 per cent alcohol by volume, the remainder of the mixture being water; hence, a quantity of alcohol when stated in proof gallons is expressed by a number just twice as large as it would be if stated in gallons of 100 per cent alcohol.

The denatured alcohol which may be used in engines in the United States must be prepared as follows, according to the regulations of the Commissioner of Internal Revenue: To 100 volumes of ethyl or grain alcohol of a strength not less than 90 per cent there must be added either 10 volumes of methyl or wood alcohol and one-half of 1 volume of benzine or 2 volumes of methyl alcohol and one-half of 1 volume of pyridin bases. The substances added to the grain alcohol will probably not be of uniform quality, and hence there will be some variability in the properties of the denatured alcohol which will affect its use as a fuel.

The following figures are fair averages or approximate values and serve to show the relative values for the different fuels:

Relative Weights of Different Fuels.

Substance	Specific Gravity	Pounds per Gallon
Gasoline	0.71	5.9
Kerosene	.80	6.7
95 per cent ethyl alcohol	.82	6.8
90 per cent ethyl alcohol	.83	6.9

The presence of any solid dissolved in alcohol tends to increase the specific gravity of the liquid and thus apparently lowers the percentage of alcohol present as determined by the hydrometer.

The two most important properties of a liquid fuel, which determine its availability or adaptability for use in an engine, are its heat of combustion and its volatility. The useful work which can be obtained by burning a definite amount of any fuel is in general approximately proportional to the amount of heat generated by the combustion of the fuel. In this amount of heat the various fuels differ greatly. Moreover, a liquid fuel must be converted into a gas or vapor before it can be burned in an explosion engine. Hence the ease or difficulty of vaporizing the fuel has a great effect in determining the form and complexity of the vaporizing apparatus, and also

has considerable influence upon the economy of the engine and the general difficulties that may be encountered in its satisfactory operation.

Heat of Combustion.

The heat of combustion of fuels is determined experimentally by burning a known weight of the fuel in a calorimeter, in which the heat generated is absorbed by a surrounding mass of water. The unit used in this country for measuring the amount of heat is the British thermal unit (B. T. U.), and the amount of heat produced is determined by weighing the amount of water heated and measuring its rise in temperature. The heat of combustion of the various petroleum oils varies between 19,000 and 21,000 British thermal units per pound and 20,000 is used as an average value. The experimental value for pure alcohol is about 12,700 British thermal units per pound.

When a fuel has a definite chemical composition, the air necessary for its combustion can be exactly calculated. Hence, this calculation can be made for pure methyl or ethyl alcohol, but can be made only approximately for a fuel like gasoline, which is a mixture in variable proportions of a large number of different chemical substances.

In an actual engine the amount of air is proportioned to the amount of vapor, not by any exact measurement of either, but by trial to secure either the best results in maximum power or in minimum fuel consumption. In such case the experimenter has no knowledge of the amount of fuel supplied but unburned. In the French tests by Sorel, the exhaust gases were analyzed chemically with a view to determining the amount of air supplied. An engineer operating the engine, however, has no means for determining such results, and, in fact, cares very little just what quantity of air is being supplied so long as it is clear that no fuel is passing away unburned or so long as the engine is doing the proper amount of work with the minimum consumption of fuel.

Before any liquid fuel can be used in the usual form of explosion engine, it must be vaporized, and this vapor must be mixed with air in proper proportions. Thus, the preparation of the combustible mixture involves three steps: First, vaporization of the fuel; second, mixture of the fuel vapor and air; and, third, the proper adjustment of the proportions of fuel and air.

The differences in the devices used in engines to accomplish these objects constitute the widest variations in the detailed design of existing engines. In some of these devices the fuel is boiled in a separate chamber, called a vaporizer, from which the vapor flows into a stream of air entering the engine, the amount of vapor being regulated by a valve just as in the case of an engine using illuminating or producer gas.

In another type of vaporizer the fuel is dropped on a hot plate over which the air flows, the proportion of fuel being regulated by the amount of liquid fuel forced against the plate. Kerosene requires a high heat to vaporize it completely, since its boiling point is high, and hence it is much used with vaporizers of the hot-plate type. Alcohol will work satisfactorily with a vaporizer of this type if the temperature of the hot plate is properly regulated.

Gasoline is easily vaporized at ordinary atmospheric temperatures and hence requires no hot plate or heated vaporizing chamber. Usually the liquid gasoline is admitted directly into the air entering the engine through a device known as the carbureter, which is intended to regulate the proportion of fuel and to spray it uniformly through the mass of air so that as the liquid spray turns into vapor it will produce a homogeneous mixture of air and vapor. Alcohol can also be used in a gasoline carbureter.

As with all substances which liquefy at ordinary temperatures, there is a definite limit to the amount of alcohol vapor which can exist in a cubic foot of space at any given temperature. Assuming the laws for perfect gases to hold,, at any given constant temperature, the weight of alcohol vapor present in a cubic foot of space is proportional to its vapor pressure and is usually measured or represented by this vapor pressure.

In the investigations conducted by the Department each engine tested was fitted with a suitable brake for absorbing the power developed. Engine No. 1 was provided with a special water-cooled pulley, attached to the fly wheel. The pulley had an internal rim for retaining the cooling water and an external rim for retaining the brake in place. The latter was formed of wooden blocks, attached to a belt whose length could be adjusted by a screw. A wooden arm, connected to the belt, rested upon platform scales. On all the slow-speed engines similar wooden block band brakes, bearing upon platform scales, were used.

Each automobile engine was fitted with a special water-cooled pulley, attached to its fly wheel. The pulley was made by cutting out a disk of three-eighths-inch boiler plate, which was bolted to the fly wheel. The outside face of the disk was grooved to receive the rim of a standard cast-iron belt pulley 5 inches wide. The other edge of the pulley rim was fitted to another ring of boiler plate in a similar manner. Bolts passed from plate to plate, as shown in the illustrations. A rope brake was used on this pulley. Each end of the rope was fastened to a spring scale, which in turn was suspended from the arm of a beam pivoted to a standard. The other end of the beam was held by a chain block. A movement of the chain block increased or decreased the tension on the rope. The rotation of the engine tended to pull one side tighter than the other, just as is the case with a windlass. A heavy scale, capable of recording 400 pounds, was attached to the beam near its center and carried the tight side of the rope. The other end of the rope was attached to a lighter scale, capable of recording a maximum of 24 pounds. With this brake a 200-pound pull was registered on the heavy scale, with only eight pounds on the smaller scale, and the tension could be quickly and rapidly varied by the chain block.

The speed of the engines was obtained by actual counting, using a stop watch, by a hand speed counter and by a tachometer. Usually the speed was determined by more than one observer, so as to reduce the chances of error.

The ordinary formula was used for computing the brake horse-power,

$$\text{BHP}=\frac{2\,ii\,\text{RWN}}{33{,}000},$$

in which R = the brake arm in feet, W = the brake load in pounds and N = the number of revolutions per minute.

On all the slow-speed engines, indicator cards were taken not only for the purpose of determining indicated horsepower, but also for studying the characteristics of the combustion, compression, and other conditions in the cylinder. For this use a new outside spring indicator was loaned for these tests by the manufacturers of the indicator.

It was difficult to determine the proper mean effective pressure to use in computing indicated horsepower, because successive strokes often gave indicator diagrams of very different size and shape. Hence it was impossible to determine exactly the average mean effective pressure for a stated period of time. This difficulty was avoided so far as possible by taking a large number of cards. When there were numerous differing cycles drawn on one sheet, usually the planimeter point was moved around on a line as near the average of the different cycles as could be determined by eye. This gave a sort of graphical average which seemed the best that could be done under the circumstances. No attempt was made to measure the area of the lower or suction loop on the indicator cards with the planimeter; the mean effective pressure is based upon the measured area of the upper loop only.

The number of explosions per minute was determined in hit-and-miss governed engines both by counting the number of fuel admissions and also by listening to the exhausts. This dual method is necessary because, under certain circumstances, a charge may miss fire and an explosion may be recorded from observations of fuel admissions where one did not really occur.

The indicated horsepower was computed by the usual formula,

$$IHP=\frac{PLAN}{33,000},$$

in which P = mean effective pressure in pounds per square inch; L = stroke of piston in feet; A = area of piston in square inches; and N = number of explosions per minute.

The engines were in all cases piped for alcohol fuel and also for either gasoline or kerosene, so that one could be switched on and the other off at any time. In addition a third connection was provided for the measuring tanks. Any variation in the adjustment of the engine was secured when using the permanent supply tanks before switching on the measuring tanks, and care was exercised to insure that there was no residue between the valve and the engine itself before measurements were taken.

The alcohol used in these investigations was bought on competitive bids as 95 per cent commercial alcohol and cost in barrels 33½ cents per wine gallon without the tax.

The calorific power or heat of combustion of the alcohol used in these tests was found by calorimeter determinations to be 11,880 British thermal units per pound.

The gasoline used in the experiments, known as "motor gasoline," was bought in New York City at 15 cents a gallon by the barrel and had a specific gravity of about 0.71 at 60° F.

Its heat of combustion, high value, as determined by a calorimeter, was 21,120 British thermal units per pound.

Conclusions.

The following general conclusions are drawn as a result of all the investigations reported in detail in the bulletin:

(1) Any gasoline engine of the ordinary types can be run on alcohol fuel without any material change in the construction of the engine. The only difficulties likely to be encountered are in starting and in supplying a sufficient quantity of fuel, a quantity which must be considerably greater than the quantity of gasoline required.

(2) When an engine is run on alcohol its operation is more noiseless than when run on gasoline, its maximum power is usually materially higher than it is on gasoline and there is no danger of any injurious hammering with alcohol such as may occur with gasoline.

(3) For automobile air-cooled engines alcohol seems to be especially adapted as a fuel, since the temperature of the engine cylinder may rise much higher before auto-ignition takes place than is possible with gasoline fuel; and if auto-ignition of the alcohol fuel does occur no injurious hammering can result.

(4) The consumption of fuel in pounds per brake horsepower, whether the fuel is gasoline or alcohol, depends chiefly upon the horsepower at which the engine is being run and upon the setting of the fuel supply valve. It is easily possible for the fuel consumption per horsepower hour to be increased to double the best value, either by running the engine on a load below its full power or by a poor setting of the fuel supply valve.

(5) These investigations also showed that the fuel consumption was affected by the time of ignition, by the speed, and by the initial compression of the fuel charge. No tests were made to determine the maximum possible change in fuel consumption that could be produced by changing the time of ignition, but when near the best fuel consumption it was shown to be important to have an early ignition. So far as tested the alcohol fuel consumption was better at low than at high speeds. So far as investigated, increasing the initial compression from 70 to 125 pounds produced only a very slight improvement in the consumption of alcohol.

(6) It is probable that for any given engine the fuel consumption is also affected by the quantity and temperature of cooling water used and the nature of the cooling system, by the type of ignition apparatus, by the quantity and quality of lubricating oil, by the temperature and humidity of the atmosphere, and by the initial temperature of the fuel.

(7) It seems probable that all well-constructed engines of the same size will have approximately the same fuel consumption when working under the most advantageous conditions.

(8) With any good small stationary engine as small a fuel consumption as 0.70 pound of gasoline, or 1.16 pounds of alcohol per brake horsepower hour may reasonably be expected under favorable conditions. These values correspond to 0.118 and 0.170 gallon respectively, or 0.95 pint of gasoline and 1.36 pints of alcohol. Based on the high calorific values of 21,120 British thermal units per pound of gasoline and 11,880 per pound of alcohol, these consumptions represent thermal efficiencies of 17.2 per cent for gasoline and 18.5 per cent for alcohol.

But calculated on the basis of the low calorific values of 19,660 British thermal units per pound for gasoline and 10,620 for alcohol, the thermal efficiencies become 18.5 for the former fuel and 20.7 for alcohol. The ratio of the high calorific values used above is, gasoline to alcohol, 1.78. The corresponding ratio of the low calorific values is 1.85. The ratio of the consumptions mentioned above is, alcohol to gasoline, 1.66 by weight, or 1.44 by volume.

MINUTES OF THE MEETING OF THE PACIFIC COAST GAS ASSOCIATION.

Resumed Wednesday Morning, September 13, 1907, at 10:10 a. m.

The President: We will try and close our meeting by 1 o'clock, in order that the ladies of our party, and as many of the members as we can procure conveyances for, can take a trip to the Big Trees this afternoon at 1:45. This will not interfere at all with the outing to-morrow to the cement works. We will all meet at the Sea Beach Hotel for this ride to the trees. Do not forget the banquet at 7 p. m., the ladies accompanying the members are invited.

The President: Meeting called to order at 10:10 a. m., Mr. John Martin presiding.

The President: We will now hear Mr. Valentine's paper on "Experiences."

The President: Any discussion upon any of the various subjects? If not, we will pass it up and call upon Mr. Geo. S. Colquhoun for "Wrinkles."

(Mr. Colquhoun's paper read.) (Applause.)

The President: Is Mr. Hollidge here?

Mr. Britton: His novelties are on exhibition.

The President: We will now have "Lamp Black," a composite paper, by several members.

(Paper read by the President. Applause.)

Mr. Clark: We have used lamp black for water-gas making, and we came within about twenty-five per cent of the capacity of the machine, and it worked very well. The only trouble at first was the burning-out of grates, and I put in some water grates with circulating water, and, after that, it worked very nicely.

The President: How about oil to enrich?

Mr. Clark: About the same amount of oil.

Mr. Lowe: What kind of oil? That is, what gravity?

Mr. Clark: Twenty-seven degree B.

Mr. Lowe: What kind of oil? Crude oil? From what field?

Mr. Clark: Santa Maria, I think.

Mr. Keyes: Do I understand that a grate bar made of the same size cast iron is much more durable than wrought iron?

Mr. Jones: Mr. Colquhoun is the man who got up that style of grate bar; he improved on the old wrought-iron bar.

The President: Tell us why.

Mr. Colquhoun: The wrought-iron bars burned away, and were not so durable as cast iron.

The President: Any further discussion on this paper? If not, we will now hear a paper entitled "Moving 30,000 Barrel Oil Tank by Water."

Mr. Jones: I happened not to be the author of this

paper; it was written by one of the assistants in the gas department, so I will read it.

(Paper read by Mr. Jones.)

The President: We have still another topic, entitled "Something New About Determining Heat Units," by Frederick C. Jones.

(Paper read by Secretary.)

The President: The next will be "Practical Suggestions from a Practical Man," by Stephen A. Byrne.

The President: Any discussions on this paper?

Mr. Lowe: The suggestions are all undoubtedly very excellent ones, but I am of the opinion that almost all gas companies to-day have observed suggestions made in the paper. If they haven't, it is an excellent paper to read.

The President: We have one more paper, by George C. Holberton, entitled "One Year After."

The President: The next order of business will be the report of the committees.

Mr. Jones: Mr. Rix has kindly consented to read the report of the committee on the President's address.

Mr. Rix: The committee appointed to report on the address of the President, desires to report as follows:

"That the President, in his remarks about the American Gas Institute, has voiced the sentiment of the Pacific Coast Gas Association, and this committee feels that it can state, in no uncertain terms, that this Association will act in entire harmony with the American Gas Institute in the matters of investigation and research into either new or old fields of interest and benefit to the gas industry. We will willingly do our share, not only as a duty, but with enthusiasm, and our President has stated our views, when he says that the 'Existence of this National Association should spur on the members of the Pacific Coast Gas Association to greater and nobler achievements.'

"We feel that our President has sounded the initial note of warning, that the commodity which we manufacture and sell must follow in the line of all others, and in that the price must be advanced, and if it is equitable, that the increasing cost of labor and material reduces the purchasing power of a dollar in other directions. Why should public sentiment or politics or municipal legislation seek to disbeen a greater proportionate advance in the cost of oil, which is our raw material, than in the materials which form the basis for the manufacture of most commodities, and it is right and just that our selling prices should be increased. We appreciate that our President has been active in giving the public cheaper gas, as the price of oil decreases, and the public should rightfully submit to a just proportionate increase in the cost of gas, as the price of oil and attendant manufacturing expenses advance.

"We feel that the judgment, and foresight, and courage, of our President is fully vindicated in the splendid results achieved by the three large gas engines at Martin Station.

"It requires an unusual quality of mind and judgment to step into a new field, almost unaided, and in the face of such adverse engineering criticism, and select and install such tremendous units of gas-engine power, and we are proud of the success, which we share with our President, that is now attending the results of this installation.

"We believe that our President has made a very wise and far-reaching statement, and one to which we desire especially to call the attention of the members of this Association, when he says, as follows:

"'The many and varied uses to which gas, in the last three years, has been applied, notably in metallurgical and other manufacturing directions, indicate the point of the necessity for the education of engineers through a collegiate course on a broader scale than the mere practical experience now obtained by most of the superintendents in charge of plants in a proper direction of this very extensive use of our commodity.'

"Your committee concludes with the statement that very much of the enthusiasm, which is everywhere a part of this Association, is due to the interest, the generosity and the personal example and attention of our President, Mr. John Martin, and we feel that no word of praise or thanks can adequately show our appreciation, but we feel that in our loyalty to our profession, and to this Association, and in our endeavors to continually raise the standard of our product, in quality and with economy and satisfaction, both to the public and our own commercial interests, we shall render the most substantial return for all of his endeavors in our behalf.

"Respectfully submitted,
"E. C. JONES,
"VAN E. BRITTON,
"E. A. RIX."

Secretary: Gentlemen, you have heard the report of the committee. Those in favor of accepting same will answer by saying "aye"; those to the contrary, "no." Unanimously adopted.

The President: It is now in order to appoint a committee on award of medal.

Mr. Lowe: Mr. President, I desire to report, on behalf of the committee appointed to purchase and present to Mr. E. C. Jones the gold medal of the Pacific Coast Gas Association, which was last year awarded to him for the paper which he then presented. A design was secured and the medal purchased, and is now ready for formal presentation, which will take place at the banquet this evening.

The President: Are there any other committee reports?

The President: Report of committee on Secretary's report. Report approved by committee and ordered placed on file.

The President: Gentlemen, something by the Secretary.

Mr. Britton: I regret very much to state that the entire quota of officers of the Association, partly through neglect, and partly through misinformation, neglected to announce in the list of deaths of members, one of our older members, who passed away at San Jose during the past year. His death was brought to my attention at the time of his death. It was E. C. Randall, whom, perhaps, a number of you will remember as having been associated with the San Jose Company and Appliance Company, and in later years for himself in the installation of gas furnaces throughout the interior. He was always a very genial and companionable fellow at our meetings, very earnest and active in the work; and I make the suggestion that Mr. Jones, who has acted as committee on obituaries, and very ably so, prepare an obituary for publication in our proceedings, on the death of Mr. E. C. Randall. He died in San Jose, on Friday, the 23rd of February, last. He was a married man, left a widow, but no children. He was born in Crimsby, Ontario, Province of Canada, in 1855, being fifty-one years of age at the time of his death. He had occupied a number of responsible positions throughout the State.

The President: I appoint Mr. Jones to act as a committee of one in that capacity.

Mr. Jones: Mr. President, I find that the committee that acted on the President's address neglected one item, that concerning the engrossing of the resolutions on the death of our honorary member, Mr. Wm. G. Barrett. Please consider that a part of the report.

The President: I appoint on that committee of resolutions, Mr. E. C. Jones.

Mr. Britton: What I am about to introduce is somewhat of an innovation, possibly not called for by our Constitution or By-Laws, neither of which we ever live up to with any respect, but I think I am justified, under all the circumstances of the case, and the matter comes absolutely without solicitation on the part of the party interested. One of our Past Presidents, Mr. C. E. Burrows, from Walla Walla, was a charter member of the Association, a man who has enlivened every proceeding by his presence, and

one of the most genial gentlemen that it was ever my pleasure to meet in business or socially, has severed his connection, at the present time, with the gas works, and has practically retired. He brought up his children in the gas business, and has determined to spend the few remaining years left for him in peace and quiet. I think it would be a fitting testimonial to his worth as a member of the Association, and as a President of this Association, he ably conducted the meeting over which he presided, to place him on the honorary list. I think the honorary list was made for just such cases as this. For myself, I would like always to be an active member of the Association, and if, at any time I should decide to withdraw from the gas business, I should like to have the same honor conferred on me, providing I became inactive; but if I were able to attend the meetings, I would, of course, fight against such a proceeding in my behalf. Mr. Burrows is not here, and he would probably fight against the same proposition; if present, he would no doubt desire to remain an active member.

I, therefore, make the motion that Mr. C. E. Burrows, Past President of the Pacific Coast Gas Association, be made, from this time forward, an honorary member of the Pacific Coast Gas Association.

The President: You have heard the motion of Mr. Britton, duly seconded; all those in favor of same, answer by saying "aye."

The President: Unanimously carried and adopted.

The President: We will now have report of the nominating committee.

Mr. Jones: The nominating committee begs to report as follows: For President, C. O. G. Miller, San Francisco; for Vice-President, Geo. S. Colquhoun, San Francisco; for Secretary and Treasurer, John A. Britton, San Francisco. Directors: B. F. Pierson, Los Angeles; Chas. Hughes, Red Bluff; R. L. Clark, San Diego; W. F. Boardman, San Francisco.

President: Gentlemen, you have heard the report of the nominating committee. What is your pleasure?

Mr. Grow: I make a motion that report be adopted.

The President: All members will signify their willingness to adopt same by saying "aye."

The President: Unanimously adopted.

The President: Any other business, Mr. Secretary?

Mr. Britton: There is one matter that we passed over until this time, and that was the question of the acceptance of the Alaska-Yukon Exposition, to meet in Seattle in 1909, at the time of the Exposition.

Mr. Lowe: While we are unquestionably deeply grateful for the invitation, it seems to me that it would be almost impossible for the Association to meet at that place. We find that the nearer we get to San Francisco, the better off we are. Under the circumstances, I think it would be well to instruct the Secretary to explain our position and express our thanks for the invitation.

Mr. Britton: I second Mr. Lowe's motion.

The President: All those in favor of this motion will answer by saying "aye."

The President: Unanimously carried.

Mr. Newbert: Mr. President, I think it is now in order for us to extend a vote of thanks to our hosts for the use of this hall, and for the many privileges and courtesies extended during our stay here, and, therefore, I move that a vote of thanks be extended to them.

The President: Motion seconded that vote of thanks be extended to the management of the Casino for the use of the hall, etc. All those in favor of motion, answer by saying "aye."

The President: Unanimously carried.

Mr. Britton: I think that a vote of thanks of the Association should be extended to the Coast Counties Company for its many courtesies to our Association during its stay in Santa Cruz. All those in favor of seconding motion, will kindly rise. (Every member rising.)

The President: In conclusion, as President of the Coast Counties Company, I wish to extend the invitation to all of you who desire to visit our gas works. Mr. Van Britton will show you our works. Also, it will be an excellent opportunity to look over the power plant.

The President: If there is nothing further, I recommend that the 15th Annual Convention of the Pacific Coast Gas Association come to a happy close.

Adjourned.

The regulations of the Association provide for the giving of but one medal annually; otherwise, last year's committee would, in addition to having awarded a medal to Mr. Jones for his excellent paper, have also awarded one to Mr. E. A. Rix, for his equally worthy paper, entitled "Some Economics in High-Pressure Gas Transmission," and which subject is of vast importance to the gas profession. This paper was in continuation of one read by Mr. Rix before the Association in 1905, and which was entitled "The Compression and Transmission of Illuminating Gas."

I therefore beg leave to report that it has been decided to award to Mr. Rix, for his papers, the medal which would otherwise have been awarded this year had a paper of sufficient merit been presented, but in view of the decision to award the medal to Mr. Rix, the question of considering this year's papers has not been touched upon. (Applause.)

REPORT OF SECRETARY AND TREASURER

PACIFIC COAST GAS ASSOCIATION.

September 15th, 1906.		
Balance on hand General Fund		$ 923.64
Balance on hand Library Fund		1,304.39
Total		$2,228.03
Dues 1906-07	$1,240.00	
Dues 1907-08	15.00	
Initiation Fees	145.00	
LIBRARY FUND:		
Donation Los Angeles G. & E. Co.	$100.00	
Donation The Edison Electric Co.	100.00	200.00
Miscellaneous a/c Bank Interest	28.49	
14TH CONVENTION:		
Contribution John Martin	$440.75	
From Journals a/c Reporting fees	60.00	500.75
Sale of Rix Pamphlet	10.00	
Sale of Volume 6	5.00	
Advertisements in Vol. 6	574.75	$2,718.99
Total Receipts		$4,947.02
Less Uncollected for Ads. in Vol 6		20.00
		$4,927.02
Expenses 14th Annual Meeting	$1,323.85	
Expenses Printing, etc., Volume 6	1,039.40	
Expenses Secretary's Office	517.09	
Expense Printing Rix Pamphlet	299.46	
Purchase of Books, etc., Library	57.95	$3,237.75
September 10th, 1907.		
Balance General Fund		$ 242.83
Balance Library Fund		1,446.44
		$4,927.02
VOLUME 6.		
Cost of Printing, Postage, etc.	$1,039.40	
Advertisements and Sales	559.75	
Net Cost of Volume		$ 479.65
Expenses 14th Meeting	$1,323.85	

Less Returned by Jno. Martin and Journals...	507.75	
Net Expense 14th Meeting		$ 816.10
Cost of Printing Rix Pamphlet	$ 299.46	
Sales Rix Pamphlet	10.00	
Net Cost Rix Pamphlet		$ 289.46
General Expenses Administration		575.04
		$2,160.25
Due from Members		$ 230.00
Due for Advertisements		20.00

MEMBERSHIP.

RESIGNATIONS.

1. C. E. Breckenridge, College Point, N. Y.
2. H. R. Shade, Virginia City, Nev.
3. Geo. B. Ellis, Redlands, Cal.
4. U. M. Slater, Reno, Nev.
5. Light Publishing Co., New York, N. Y.
6. Pomona and Ontario Light & Fuel Co., Pomona, Cal.
7. Riverside Light & Fuel Co., Riverside, Cal.
8. Whittier Light & Fuel Co., Whittier, Cal.
9. Roderick McKay, Los Angeles, Cal.
10. J. W. Finn, San Francisco, Cal.

DEATHS.

1. Wm. G. Barrett, Honorary Member, Oakland, Cal.
2. E. C. Randall, San Jose, Cal.

MEMBERS DROPPED OWING TO PRESENT WHEREABOUTS BEING UNKNOWN.

1. Edison Co., Los Angeles, Cal.
2. Guenther, C. M., Chicago, Ill.
3. Mills, John B., Chicago, Ill.
4. Ross, A., Portland, Ore.
5. Thompson, J. R., San Francisco, Cal.

MEMBERSHIP, SEPT. 15, 1906.

On Books, Regular Members	199	
On Books, Associate Members	66	265
ELECTED MEETING, SEPT. 17, 1906.		
Regular	43	
Associate	8	51
		316
Died	2	
Resigned	10	
Dropped	4	16
		300

LIST OF APPLICATIONS FOR MEMBERSHIP.

REGULAR.

1. R. L. Cardiff, Supt. Elec. Dept., Santa Cruz Gas & Elec. Co., Santa Cruz, Cal.
2. E. Howard Corbett, Gas Engineer, Seattle, Wash.
3. Victor Etienne, Jr., Vice-President Stockton Gas & Elec. Co., Stockton, Cal.
4. Paul C. Funk, Supt. Santa Cruz Gas & Electric Co., Santa Cruz, Cal.
5. Chas. W. McKillip, Manager, Sacramento Elec., Gas & Ry. Co., Sacramento, Cal.
6. E. B. Walthal, Chief Consumers' Dept., San Joaquin L. & P. Co., Fresno, Cal.
7. Worth W. Wilson, Manager, Watsonville Light & Power Co., Watsonville, Cal.
8. A. C. Wishan, Manager, San Joaquin Light & Power Co., Fresno, Cal.
9. Roy Edwin Thompson, Asst. Supt., San Diego Cons. Gas & Elec. Co., San Diego, Cal.
10. Stephen A. Byrne, City Light & Water Inspector, 1646 Alabama Street, San Francisco, Cal.
11. George L. Benbow, Assistant, Gas Department, Oakland Gas, Light & Heat Co., Oakland, Cal.
12. W. B. Barry, Assistant, Gas Dept., California Gas & Electric Corp., 925 Franklin Street, San Francisco, Cal.
13. S. Waldo Coleman, General Manager, Union Traction Co., Santa Cruz, Cal.
14. Harry Latimer Strange, Supt. Gas Works Co., Honolulu Gas Co., Honolulu, H. I.
15. John Mulgrew, Supt., Oakland Gas, Light & Heat Co., Oakland, Cal.
16. G. B. Furniss, Asst. Manager, Oakland Gas, Light & Heat Co., Oakland, Cal.
17. John F. Parker, Sales Manager, Eclipse Gas Stove Co., Rockford, Ill.
18. H. L. Delaney, Appliance Dept., Metropolitan Light & Power Co., San Francisco, Cal.
19. H. R. Bashford, Rudd Water Heaters, 250 The Delbert Block, San Francisco, Cal.
20. Chas. F. Stamps, Jr., Manager Los Angeles Gas Appliance Co., 639 So. Hill Street, Los Angeles, Cal.
21. George W. Hark, Supt. Sparks Dept., Reno Power, Light & Water Co., Sparks, Nev.

ASSOCIATE MEMBERS.

1. P. J. McCoy, National Furnace Co., 117-119 California Street, San Francisco, Cal.
2. Fred Williams, Gas Generators and Furnaces, San Bernardino, Cal.
3. Geo. W. Ackerman, Gas Appliances, 519 Eddy Street, San Francisco, Cal.
4. J. D. Farwell, Manager, Los Gatos Gas Co., Los Gatos, Cal.

Approved Electrical Devices

This department from time to time will contain an illustrated description of all fittings approved by the Underwriters' National Electric Association.

CABINETS.

Paiste cast iron box enclosing an approved cut-out base or approved combination switch and cut-out, Edison plug or cartridge fuses. Approved Sept. 10, 1907. Manufactured by

H. T. Paiste Co., Philadelphia, Pa.

CABLES, ARMORED.

"Flexsteel." Approved Sept. 10, 1907. Manufactured by the

National Metal Moulding Co., Pittsburg, Pa.

CONDUIT BOXES.

S. E. Co. outlet boxes, types GX, HX, IX, N and O., Cat. Nos. 1904, 1905, and style 5040. Junction boxes, styles 5040, 5140, 5250, 5050, 5150, 5260 (lined or unlined), and style 2504, for use with flexible conduit or armored cable. Cat. No. 6200, with canopy cover. Approved Sept. 10, 1907. Manufactured by the

Sprague Electric Co., New York, N. Y.

CONDUIT UNLINED.

"Flexsteel" flexible steel conduit. Approved Sept. 10, 1907. Manufactured by the

National Metal Moulding Co., Pittsburg, Pa.

CUTOUT BASES, CARTRIDGE FUSE.

Knowles main line cutouts for N. E. Code, enclosed fuses, 3-30, 31-60, 61-100, 101-200A, 250V, 61-100A, 600V. Approved Sept. 10, 1907. Manufactured by

C. S. Knowles, Boston, Mass.

FLEXIBLE CORD, PORTABLE.

"Flexsteel" flexible armored cord. Approved Sept. 10, 1907. Manufactured by the

National Metal Moulding Co., Pittsburg, Pa.

GROUND CLAMPS.

"G. V." ground clamps. Type A, sizes for ½ to 3-inch pipe. Approved Aug. 21, 1907. Manufactured by

The Gillette-Vibber Co., New London, Conn.

MISCELLANEOUS.

Swan terminal strain relief, porcelain and fibre discs to replace knot in cord in sockets. Approved Sept. 10, 1907. Manufactured by the

Swan Electric Co., Boston, Mass.

S. E. Co., armored cord fittings. Cat. Nos. 5302, 5303, and 5304, for use with approved rosettes and sockets, and at terminals. Approved Sept. 10, 1907. Manufactured by the

Sprague Electric Co., New York, N. Y.

PANEL BOARDS.

Spranley & Reed, 125 and 250V, 2 and 3-wire boards equipped with knife switches and extensions for cartridge enclosed fuses. Approved Sept. 10, 1907. Manufactured by

Spranley & Reed, New Orleans, La.

RECEPTACLES FOR ATTACHMENT PLUGS.

"Mesco" flush receptacle and plug 5A, 250V. Cat. No. 16413. Approved Sept. 10, 1907. Manufactured by

Manhattan Electric Supply Co., New York, N. Y.

RECEPTACLES, STANDARD.

P. & S. porcelain wall sockets, Cat. Nos. 2371, 02371, 237, 0237, 247, 0247, 1087 and 107. Cleat receptacles, Cat. Nos. 870 and 871. Moulding receptacles, Cat. Nos. 670 and 770. Sign receptacles, Cat. Nos. 973, 977, 777, 1072 and 975. Removable ring type, Cat. Nos. 577, 578, 877 and 988. Approved Sept. 10, 1907. Manufactured by

Pass & Seymour, Solway, N. Y.

RECEPTACLES, WEATHERPROOF.

P. & S. Cat. Nos. 1160, 1161, 972, 974 and 1165. Cat. No. 1162, a porcelain sub-base for use with Nos. 1160 and 1161, also Cat. Nos. 820 and 971, for indoor and outdoor use. Approved Sept. 10, 1907. Manufactured by

Pass & Seymour, Solway, N. Y.

RHEOSTATS.

"Westinghouse" motor starting rheostats. Open wire "bar" types and "grid" types, 125 to 650 volts inclusive. "1907" designs. One-fourth to 120 horsepower. With single contact term. Approved Sept. 10, 1907. Mfd. by the

Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

"Westinghouse" regulating rheostats. Open wire "bobbin" and "bar" types and "grid" type. 125 to 650 volts inclusive. For field control or other similar continuous duty service. Adjustable and fixed resistance patterns. Approved Sept. 10, 1907. Mfd. by the

Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

ROSETTES, FUSELESS.

"National." For use with "National" metal moulding. Approved Sept. 10, 1907. Mfd. by the

Peru Electric Mfg. Co., of Peru, Ind.,
For the National Metal Moulding Co., of Pittsburg, Pa.

SOCKETS, STANDARD.

Berjamin Right Angle. Brass shell keyless right-angle socket, Cat. No. 411. Approved for use on fixtures only Sept. 10, 1907. Mfd. by the

Benjamin Electric Mfg. Co., Chicago, Ill.

SWITCHES, COMBINATION CUTOUT.

G. E. combined Edison plug cutout and lever switches in iron boxes, all capacities, 2-2 wire and 3-3 wire, 125 and 250 volts. Catalogue Nos. 45,008-45,107, inclusive. Approved Sept. 10, 1907. Mfd. by

General Electric Co., Schenectady, N. Y.

SWITCHES, SURFACE SNAP, SUB-BASES.

P. & S. Porcelain, round and square types for 1, 2 and 3 switches. Cat. Nos. 16, 17, 18 and 19. Approved Aug. 15, 1907. Mfd. by

Pass & Seymour, Solway, N. Y.

SWITCH BOXES.

S. E. Co. For use with flexible steel conduit or armored cable. Cat. Nos. 5981-5986 (lined), Nos. 6981-6986 (unlined), Nos. 5281, 5950, 5951, 5971-8, inclusive, and 5991-8, inclusive. Approved Sept. 10, 1907. Mfd. by the

Sprague Electric Co., New York, N. Y.

RECEPTACLES, WEATHERPROOF.

Bryant. Edison and T. H. types, 3 A., 250 V., Cat. Nos. 9,407, 9,408, 9,411, 962, 1,046, 966, 39,000 and 44,912; also Street Hood Sockets, Nos. 25,706, 25,707 and 1,406. Approved August 20, 1907. Manufactured by

The Bryant Electric Co., Bridgeport, Conn.

C. E. M. Co. Cat. No. 1,225, 3 A., 250 V. Approved August 15, 1907. Manufactured by

The Conn. Electric Mfg. Co., Bantam, Conn.

G. E. Rosette Receptacle, cleat type, Cat. No. 40,449, 3 A., 250 V. Approved August 20, 1907, for out-door use only. Manufactured by

The General Electric Co., Schenectady, N. Y.

G. M. & S. Co. Cat. No. 9,500, 3 A., 250 V. Approved August 20, 1907. Manufactured by

The General Manufacturing & Supply Co., Trenton, N. J.

Trumbull. Cat. No. 976, 3 A., 250 V. Approved August 20, 1907. Manufactured by

The Trumbull Electric Mfg. Co., Plainville, Conn.

SWITCHES, PUSHBUTTON FLUSH.

"Arrow E." S. P. and 3-way, 10 A., 125 V.; 5 A., 250 V.; D. P. 10 A., 250 V. Approved August 14, 1907. Manufactured by

The Arrow Electric Co., Hartford, Conn.

SWITCHES, ROTARY FLUSH.

"Arrow E." S. P. and 3-way, 10 A. Approved August 13, 1907. Manufactured by

The Arrow Electric Co., Hartford, Conn.

SWITCHES, SURFACE SNAP.

"Arrow E." Approved August 12, 1907. Manufactured by

The Arrow Electric Co., Hartford, Conn.

SWITCH BOXES.

"Fanclev." Cat. No. 201. Universal Switch or Junction Box, for moulding work. Approved August 14, 1907. Manufactured by

John L. Gleason, Jamaica Plains, Mass.

RECEPTACLE, STANDARD.

G. E. Cat. Nos. 34,152 and 42,453. Two-piece porcelain base moulding types, with and without provisions for shade holders, 3A, 250V. Approved August 2, 1907. Manufactured by

General Electric Co., Schenectady, N. Y.

G. E. weatherproof rosette receptacle, cleat type, Cat. No. 40,449. Approved June 10, 1907, for outdoor use only. Manufactured by

General Electric Co., Schenectady, N. Y.

SWITCHES, PENDANT SNAP.

"Sarco" or "P. & S." 6 A and 10 A, 125 V. single-pole, two-button. Formerly manufactured by the Sarco Co., New York. Approved July 25, 1907. Manufactured by

Pass & Seymour, Inc., Solway, N. Y.

ASBESTOS.

Carey Asbestos Board. Approved September 26, 1907. Manufactured by

Philip Carey Mfg. Co., Cincinnati, Ohio.

CONDUIT BOXES, FLOOR OUTLET.

Hunt Water-tight Floor Outlet. Cat. No. 300. Cast-iron box with brass floor plate and top. Approved September 26, 1907. Manufactured by

Electric Fittings Co., Trumansburg, N. Y.

SOCKETS, WEATHERPROOF.

Knowles Cat. Nos. 9,366 and 9,366, spherical, 3-A., 250-V. Approved September 26, 1907. Manufactured by

C. S. Knowles, Boston, Mass.

Mem. Co. Porcelain Pendant Style. Cat. No. 1,024. Approved September 26, 1907. Manufactured by

Mechanical and Electrical Mfg. Co., Chicago, Ill.

The JOURNAL of ELECTRICITY POWER AND GAS
WITH WHICH IS INCORPORATED
The Engineers, Architects and Builders News

Published Weekly by
THE TECHNICAL PUBLISHING COMPANY
SUCCESSORS TO
The Journal of Electricity Publishing Company
304 Atlas Building, San Francisco.

Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Foreign subscription, $4.00. Subscriptions cannot be begun with back numbers. Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," with which is incorporated "The Engineers', Architects' and Builders' News."
Entered as second-class matter at the San Francisco Post Office, August 15, 1899.
Entered as "The Electrical Journal," July, 1895.
Entry changed to "The Journal of Electricity," September, 1895.

VOL. XIX OCTOBER 26, 1907 No. 17

EDITORIAL.

Economy In The Generation, Delivery And Utilization Of Power.

No matter from what point of view it is considered, economy in the production and use of power is essentially a commercial problem. Too often the engineer considers it solely from his own point of view. Stripped of all unnecessary qualifications the term economy, as applied to the production and use of power, is the relation of the cost of the power as utilized to the cost of all of the component parts required in the generation, delivery, and utilization of this power.

The economy of the power station is too often considered as the only factor entering into the business side of the situation. Considered solely from the standpoint of the generating station, however, the efficiency of the individual units at maximum, or most economical load, should not be the only point considered in determining the economy of the installation. Whether the plant be one where steam, gas, or water under pressure, is the primary source of power, the efficiency of the plant as a whole, including all auxiliaries at fractional loads, is often of much greater importance in determining the true economy of the plant than the efficiency of the individual parts, or machines, at their most economic load.

Again, a plant with very high initial cost of installation has a fixed charge against it which may be as burdensome financially as a plant which is so designed and installed as to require a maximum amount of fuel per unit of output. There is in every installation a sort of unconscious compromise between excessive first cost and ruinously low fuel efficiency.

Considered from the power, or generating station standpoint only, the reliability and availability for continuous use of the units of the plant should also be considered. It is quite possible that a boiler, steam engine, gas engine, turbine, or water wheel, while extraordinarily efficient, may in its construction and details of operation, be such that an abnormal amount of time is required for repairs, maintenance, cleaning, and in general preparation for service.

Power plant economy, therefore, if properly considered, from the commercial, as well as the engineering viewpoint, must take into consideration all of the above features. As an illustration, no one experienced in the use of electric power would compare, on an equal basis, the service from a plant which is available at all times without any interruption, giving thoroughly satisfactory regulation, with another system which, for any cause whatsoever, is repeatedly thrown out of commission, or the service from which is rendered unsatisfactory due to ordinary causes, which should, under proper circumstances, be foreseen and prevented.

Leaving the power station it is next necessary to consider all the appliances required in the system until the power is actually delivered. No matter in what form the power may be, whether gas, compressed air, or electricity, there will probably be transmission as well as distribution. The transmission of power may be considered as its transportation between comparatively distant points in large quantities. The distribution of power may be said to be confined to a much more limited area, while the amount of power is less than ordinarily found in transmission.

In the transmission of power by electricity, as distances are increased and higher line voltages are made possible by the perfection of better insulators, it will undoubtedly be found preferable to build long trunk lines so located that the distance between the generating station and the centers of distribution will be of minimum length. The construction of these trunk lines should be of the most permanent character, while the voltage adopted should be the highest possible which can be used.

For distribution purposes sub-stations can be built along the trunk lines, these sub-stations being as great a distance apart as circumstances will permit. The trunk lines will, therefore, be tapped for each sub-station, and the trunk line voltage reduced to the distribution line voltage by transformers of large size. The line voltage of the individual distribution systems from each sub-station may be sufficiently low to allow the use of pole type transformers for individual power users.

In any case, transformers can be used that require a minimum of attendance or supervision.

It is also quite possible that for the longest

transmission systems, for distances exceeding 200 miles, it will be impossible to use the ordinary frequencies, such as 60 or even 25 cycles per second, on account of the excessive capacity or charging current due to the high voltage and large capacity of line. In such cases it may be necessary to generate and transmit on trunk lines electrical energy at from 10 to 15 cycles per second, and install frequency changes in each sub-station to provide the higher standard frequencies to the distribution lines. Single phase alternating current railway systems at low frequencies, variable speed motors at medium frequencies, and constant speed motors and electric lights at the higher frequencies, may, with this method, all be supplied from one main generating station and trunk line.

To determine the gross economy of such long transmission systems it is evident that the cost of the additional apparatus and the reduction in the efficiency as a result of the greater number of transformations required, will, to a greater or less extent, offset the increase in efficiency of transmission resulting from the use of extremely high voltages.

In the utilization of power, there are many things that may affect the economy of the system, beginning at the generating station and terminating with the mechanical horsepower delivered, or the delivered power in any form. Where constant speed is required for continuous service, especially when using electric power, the economy of utilization is usually a maximum. In many industries and applications, however, periodic service only is desired, and in some cases a variable speed. Where electrical energy is used for power in transportation systems we find that not only will the amount of power required vary between extraordinary wide limits, but during each twenty-four hour period there may be a large portion of the time when the demand for power is small, while during comparatively short periods of time a maximum or extraordinary peak load must be delivered. The gross economy of the utilization of power depends very materially upon whether the demand is continuous and constant or periodic and irregular.

It is evidently a grievous error to base the selling price per unit of power upon such unsatisfactory bases as the indicated horse-power, or switchboard kilowatts per pound of oil, or other fuel. It is certainly remarkable that many engineers attempt this very thing with results that are often, if not always, disastrous to the financial interests he is supposed to wisely represent.

TRADE CATALOGUE.

The Standard Electrical Works, 119-121 New Montgomery Street, San Francisco, send three interesting bulletins, Nos. 56, 77 and 84, from the Electric Machinery Co., of Minneapolis, Minnesota, whom they represent. No. 77 illustrates and describes their spherical type direct current motors and generators, which are designed to utilize a form calculated to best lend itself to the wide range of uses and to embody the necessary electrical and mechanical strength to withstand the most severe operative strains. No. 84 shows their revolving field alternating current generators for 1000 kilowatts and under. Their massive and sturdy construction insures ample stiffness under the most severe operative strains.

PERSONALS.

E. H. Steele, formerly general manager of the Siskiyou Power Company, is now with the Globe Construction Company, of San Francisco.

Percy H. Thomas and N. J. Neal announce the formation of the firm of Thomas & Neal, electrical engineers, with offices in New York and Boston.

A. E. Skillicorn, formerly with Dunham, Carrigan & Hayden of San Francisco, has become purchasing agent for the Standard Electrical Works of San Francisco.

Leon Bly, formerly of the sales department, California Electrical Works, has accepted a position as consulting engineer with the Pacific Power Co., and for the next three months will be at Red Bluff.

PUBLICATIONS RECEIVED.

"Sunset Magazine" for November contains an interesting illustrated account of "San Francisco's Japanese," by Charles S. Aiken. The race topic is continued in Roby Danenbaum's story, "In Mexico To-day." "In Guadalajara," by G. V. Guyer, likewise presents a glimpse of Mexico. "Seattle and Its Millionaires," by C. B. Yandell, together with the usual bright short stories and poems, make this an interesting number.

"The Blacksmith's Guide," by J. F. Sallows, from the "Technical Press," Brattleboro, Vt., is a practical book by a working foreman, for blacksmiths. Pocket size, 4½x7 inches, 160 pages, 165 illustrations, three of which are in colors. Sells for $1.50; cloth bound. Particular attention is given to careful descriptions of hardening, tempering and case-hardening. The various chapters treat of machine forging, tool forging, hardening and tempering, high-speed steel, case-hardening and coloring, brazing and general blacksmithing. The exposition of working methods is exceedingly clear. The processes described are essentially practical. The author says but little about the sharpening of rock drills—a subject of vital interest to the Western man. Otherwise the text is to be commended.

TRADE NOTICE.

The Crocker-Wheeler Company has changed its Birmingham, Ala., office from 2119 Third Avenue to Woodward Building.

The Steel City Electric Co., of Pittsburg, Pa., have purchased the Outlet box business of the Sarco Co., New York, including patent rights, tools, machinery and stock of goods, and as soon as the stock is transferred will be in a position to take care of orders promptly.

The Cutler-Hammer Mfg. Co., of Milwaukee, Wis., some months ago announced the purchase of the Wirt Electric Co., of Philadelphia. They now state that they have consolidated the Wirt business with that of their New York plant at Park Avenue and 130th Street, where the manufacture of Wirt apparatus will be continued.

The Railway Equipment Company, of Portland, Oregon, have purchased six acres of ground on the Willamette River, three miles from Portland, where they will build shops for the rebuilding of cars and repairing of locomotives. Machinery for making frogs, switches and general track work will also be installed. The tract of land is located on both water and rail, and is one of the best manufacturing sites on the river.

LOCAL STOCKS AND BONDS

Furnished by Courtesy San Francisco Stock and Bond Exchange.

Outstanding	INTEREST	MISCELLANEOUS BONDS.	OCT. 17		OCT. 18		OCT. 19		OCT. 21		OCT. 22		OCT. 23	
			Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked
1,532,000	F & A	Associated Oil Co. 5%	75	82½	75	82½	75	82½	75	....	75	....	75	....
2,250,000	M & S	Bay Counties Power Co. 5%	92¾	....	92½	....	92½	....	92½	95	92½	....	92½	....
1,000,000	F & A	Cal. Central Gas & El. 5%	....	100	....	100	....	100	....	100	....	100	....	100
9,600,000	M & S	Cal. Gas & El. Gen. M. & C. T. 5%	....	....	69	70	69	....	69	....	69	70	69	70
900,000	J & J	California St. Cable Co. 5%	....	102½	....	102½	....	103	....	103	....	102½	....	102½
2,000,000	J & J	Contra Costa Water Co. 5%	....	100½	....	100½	....	100½	....	100½	....	100	....	100¼
1,000,000	J & J	do do Gen. Mtg. 5%	85	91	....	90	....	90	....	91	....	91	....	91
623,000	F M A N	Edison Light & Power 6%	109	....	109	....	109	....	109	....	109	....	109	....
650,000	M & S	Ferries & Cliff Ho. Ry. 6%	....	....	....	....	....	....	....	....	....	....	....	....
671,000	A & O	Geary St. Ry. 5%	50	80	50	80	50	80	50	80	50	80	50	80
610,000	M & N	Honolulu R. T. & L. Co. 6%	105	....	105	....	105	....	105	....	105	....	....	108
300,000	A & O	Lake Tahoe Ry. & T. Co. 5%	....	....	....	....	....	....	....	....	....	....	....	....
500,000	J & J	Los Angeles Elec. Co. 5%	....	100	....	100	....	100	....	100	....	100	....	100
1,300,000	J & J	Los Angeles Gas & Elec. Co. 5%	....	100	....	100	....	100	....	100	....	100	....	100
5,000,000	A & O	Los Angeles Ry. 5%	....	108	....	108	....	108	....	108	....	108	....	108
1,000,000	A & O	Los Angele Lighting Gd. 5%	100	....	101	103	100	102	100	102	100	102	....	102
1,500,000	A & O	Los Angeles Pac. R. R., 1st Con. Mtg. 5%	....	101	....	101	....	101	....	101	....	101	....	101
3,030,000	M & S	L. A. Pac. R. R. of Cal. 5%	....	99	....	100	....	100	....	100	....	100	....	100
3,000,000	J & J	Market Street Cab'e 6%	....	107	100	106	104	106	....	106	....	106	....	106
5,141,000	M & S	do Ry., 1st Cons. Mtg. 5%	....	102	....	102	....	102	....	102	....	102	....	102
100,000	A & O	Mill Valley & Mt. Tamalpais S.Ry. 5%	103	....	103	....	103	....	100	....	100	....	100	....
4,751,000	A & O	Northern Ry. Co. of (Cal.) 5%	....	110¼	....	110¼	....	110½	....	110½	....	110½	....	110½
1,498,000	J & J	North Pacific Coast R. R. 5%	....	102	....	102	....	102	....	102	....	102	....	102
1,074,000	J & D	Northern Cal. Railway 5%	105	....	105	....	105	....	105	....	105	....	105	....
980,000	J & D	Northern Cal. Power Co. 5%	....	100	....	100	....	100	....	100	....	100	....	100
6,000,000	A & O	Northern Electric Co. 5%	....	....	....	....	....	....	....	....	....	....	....	....
1,000,000	M & S	Oakland Gas Light and H. 5%	101½	105	101½	105	101½	105	101½	105	101½	105	101½	105
1,374,000	J & J	Oakland Transit Co. 6%	109	....	109	....	109	109½	109	110	109	110	109	110
1,600,000	J & J	Oakland Transit 5%	101½	....	101½	....	101½	....	101½	....	101½	....	101½	....
1,326,000	J & J	Oakland Transit Con. 5%	....	102	....	102	....	101½	....	101½	....	102	....	102
7,000,000	J & J	Oakland Traction Con. 5%	....	99	....	99	....	99	....	99	....	97½	....	97½
1,500,000	J & J	Oakland Water Co. gtd. 5%	....	95	....	95	....	95	....	95	....	95	....	95
2,000,000	A & O	Omnibus Cable Ry. 6%	....	111	....	111	....	111	....	111	....	111	....	111
1,149,000	S D M J	Pacific Gas Imp. 4%	....	92½	....	92½	....	95	....	95	....	95	....	95
8,494,000	J & J	Pacific Electric Ry. Co. 5%	100	102	101	....	101	....	101	....	101	102	100	102
4,491,000	J & J	Pacific Light & Power Co. 5%	....	98	....	98	....	97½	....	97½	....	97½	....	97½
3,000,000	J & J	Pacific Tel. & Tel. Co. 5%	....	102½	....	102½	....	102½	....	102½	....	102½	....	102½
350,000	J & J	Park & Cliff House Ry. 6%	....	104	....	104	....	104	....	104	....	104	....	104
250,000	J & J	Park & Ocean R. R. 6%	....	104	....	104	....	104	....	104	....	104	....	104
700,000	M & S	Powell Street Railway 6%	....	....	....	....	....	....	....	....	....	....	....	....
2,500,000	M & N	Sacramento Elec. Gas & Ry. 5%	94	....	94	....	94	....	94	....	94	....	....	100
6,000,000	A & O	S. P. & S. J. Valley Ry. 5%	....	111	....	111	109	111	....	110	....	110	....	110
3,000,000	J & J	S. P., Oak. & San Jose Ry. 5%	102¾	103¾	....	103¾	....	103¾	....	103½	....	103½	....	103½
1,500,000	J & J	do do 2d Mtg. 5%	....	....	....	....	....	....	....	....	....	....	....	....
1,500,000	A & O	S. J. & S. Clara Co. R. R. 4½%	....	....	....	....	....	....	....	....	....	....	....	....
642,000	A & O	Sierra Ry. of Cal. 6%	102	....	102	....	102	....	102	107½	102	107½	102	....
6,000,000	J & J	S. P. R. R. of Arizona 6% (1909)	101	101½	101	101½	101	101¾	101	101¾	101¼	....	101¼	....
4,000,000	J & J	do do do (1910)	102	....	102	102¼	....	102¼	....	102¼	....	102¼	....	102½
5,116,000	A & O	S. P. R. R. of Cal. 6% (1912)	105	....	105	....	....	....	....	....	....	....	....	....
4,127,500	M & N	S. P. R. R. of Cal., 1st c. gtd. 5%	112½	....	112½	....	112½	....	112½	....	112½	....	112½	....
3,533,000	A & O	S. P. Branch Ry. of Cal., 6%	....	122¼	....	122½	....	122½	....	122¼	....	122¼	....	122¼
81,178,000	J & J	S. P. R. R. Co., 1st Ref'd'g. 4%	....	90	89	90	89	....	89	90	89	....	88½	....
17,500,000	J & D	Spring Valley Water Co. Gen. Mtg. 4%	87¼	88¼	88	....	87	....	87	88	86½	88	86½	87½
300,000	M & S	Stockton Gas & Elec. Co. 6%	....	105	....	105	....	105	....	105	....	105	....	105
2,000,000	J & J	United Gas & Elec. Co. 5%	....	....	....	....	....	....	....	....	....	....	....	....
20,000,000	A & O	United R. R. of S. F. 4%	63	64	64½	67	64	....	64	65	64	....	64½	66
2,500,000	M & N	Valleys Counties Power Co. 5%	....	95	....	95	....	95	....	95	....	95	....	95
		Water Stocks.												
....	....	Contra Costa	....	62	....	62	....	62	....	62	....	62	....	62
6,000	Quarterly	Marin County	45	....	45	....	45	....	45	....	45	....	45	....
280,000	....	Spring Valley Water Co	....	20½	20	20¼	19¾	20¼	19¾	20¼	19½	20	19½	....
		Gas and Electric Stocks.												
37,500	....	Martel Power Co	....	....	....	....	....	....	....	....	....	....	....	....
9,340	....	Mutual Electric Light Co. (Ctfs.)	4⅝	....	4⅝	....	4⅝	....	4⅝	....	4⅝	....	4⅝	....
37,336	....	do (Extended Ctfs.)	9⅛	9⅜	9⅛	9⅜	9⅛	9⅜	9⅛	9⅜	9⅛	9⅜	9⅛	9⅜
40,000	Monthly	Pacific Lighting Co	65	....	65	....	65	....	65	....	65	....	65	....
12,000	....	Stockton Gas & Elec. Co	52	....	52	....	52	....	52	....	52	....	52	....
		Street Railroad Stocks.												
10,000	....	California	....	135	....	135	....	135	....	135	....	135	....	135
10,000	....	Geary	....	35	....	35	....	35	....	35	....	35	....	35
10,000	....	Presidio	....	25	....	25	....	25	....	25	....	25	....	25
	Semi-an.	Associated Oil Co	27½	28¼	27½	28¼	27	28¼	....	28¼	27¼	28½	27	28¼
1,625	Quarterly	Mill Valley & Mt. Tamalpais S. Ry.	110	....	110	....	110	....	110	....	110	....	110	....
180,000	Quarterly	Pac. Tel. & Tel. Co. (Pfd.)	....	80½	....	80½	....	80½	....	80½	....	80½	....	80
180,000	....	Pac. Tel. & Tel. Co. (Common)	10	11	10	....	10	....	10	11	10	11	10	11

Unlisted Securities

750,000	A & O	Bay Counties Power Co. 6%	97	....	97	....	97	....	97	....	97	....	97	....
745,000	M & S	Blue Lakes Water Co. 6%	....	....	....	....	....	....	....	....	....	....	....	....
2,000,000	A & O	California Northwestern Ry. 5%	....	106	....	106	....	106	....	106	....	106	....	106
160,000	J A J O	Marin County Water 5%	....	100	....	100	....	100	....	100	....	100	....	100
600,000	J & J	Risdon Iron Works 5%	....	100	....	100	....	100	....	100	....	100	....	100
500,000	M & S	S. F. Dry Dock 5%	100	109	100	109	100	109	100	109	100	109	100	109
8,000,000	M & N	S. F. Gas & Electric 4½%	....	95	....	95	....	95	....	95	....	95	....	95
3,926,000	J & J	S. F. & North Pacific Ry. 5%	....	104	....	104	....	104	....	104	....	104	....	104
5,500,000	J & J	South Pacific Coast Ry. 4%	....	90	....	90	....	90	....	90	....	90	....	90
....	....	Standard Electric Co. 5%	....	80	....	80	....	80	....	80	....	80	....	80
....	....	do do Gtd. 5%	....	85	....	85	....	85	....	85	....	85	....	85
750,000	J & J	Sunset Tel. & Tel. Co. 6%	....	....	....	....	....	....	....	....	....	....	....	....
2,250,000	A & O	Sunset Tel. & Tel. Co. 5%	....	103½	....	103½	....	103½	....	103½	....	103½	....	103½
1,000,000	M & N	Sutter Street Railway 5%	....	103	....	103	....	103	....	103	....	103	....	103
		Stocks.												
50,000	Monthly	Gas Consumers' Association	....	18	....	18	....	18	....	18	....	18	....	18
100,000	Monthly	Northern Cal. Power Co	....	24¾	....	24¾	....	24¾	20	24½	....	24¼	20	23
....	....	Pac. Gas & Elec. (Pfd.)	....	45	....	45	....	45	....	45	....	45	....	45
....	....	Santa Cruz Port. Cement	....	47½	....	47½	....	47½	....	47½	....	47½	....	47½
....	....	Standard Port. Cement (New)	....	50	....	50	....	50	....	50	....	50	....	50
50,000	Monthly	Truckee Electric Co	14	....	13½	....	13½	....	13½	....	13½	....	13½	....

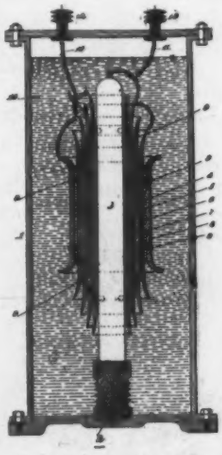
PATENTS

Electric, Gas and Water.

Specially reported for the Journal of Electricity, Power and Gas.

ELECTRICAL CONDENSER. 867,579. Leon Gerard, Brussels, Belgium, assignor to Percy Thompson, East Orange, N. J.

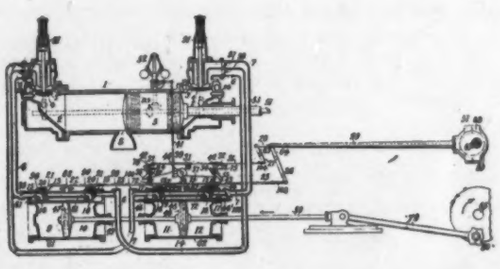
In an electrical condenser, the combination of concentric



condensing surfaces having outwardly flared ends producing spaces of gradually increasing width towards the ends of the cylinders, such cylinders being made progressively shorter as their diameters are increased, and a liquid dielectric filling the spaces between the cylinders.

REGULATING APPARATUS FOR INTERNAL-COMBUSTION ENGINES. 867,565. Joseph E. Aue, New York, N. Y., assignor to De La Vergne Machine Company, New York, N. Y.

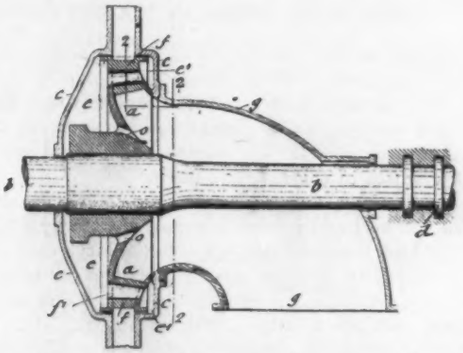
In regulating apparatus for internal combustion engines, the combination of an engine proper, a fluid-fuel pump connected with the engine and with a source of fluid-fuel a regulating valve controlling communication between the pump and the source of fluid-fuel and operative from a position of opening such communication to a position of closing such com-



munication and vice versa, a valve-operating mechanism for periodically moving the valve into one of such positions, a second valve-operating mechanism for periodically moving the valve into the other of such positions, and automatic governing mechanism actuated by the engine and periodically determining the phase or instant of operation of the second valve-operating mechanism.

TURBINE. 867,656. Max Haeberlein, New York, N. Y., assignor to The Pelton Water Wheel Co., San Francisco, Cal.

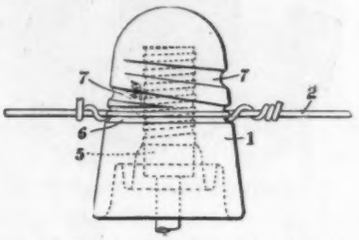
In a turbine, the combination, with the runner and its shaft, of a casing surrounding the runner-crown and the runner-shaft and forming annular spaces between the runner and



casing at both sides of the runner, the runner-bottom being provided with inclined outlet-channels, and the vanes of the runner with transverse channels near their outer ends for equalizing the pressure in the annular spaces between the runner-crown and casing at opposite sides of the runner.

INSULATOR. 867,901. John C. Barclay, New York, N. Y.

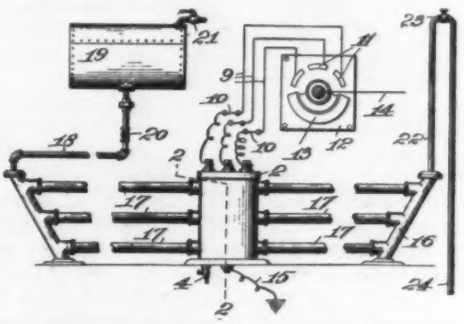
An insulator, comprising a tapering body of vitreous material having a screw threaded pin-socket adapted to receive a supporting pin and having, between the ends of such pin-



socket and in the exterior surface of the insulator, a tie-wire channel extending around the insulator and a spiral channel opening from such tie-wire channel and extending spirally around the insulator toward the smaller end thereof and constituting a tie-wire-thread, the direction of tie-wire-thread and thread of the pin-socket being opposite.

ELECTRIC WATER-HEATER. 867,863. Mendal W. Willson, St. Louis, Mo.

An electric water-heater, constructed with a tank, there being a groove formed in the bottom thereof, adjacent the wall, a plurality of circulation tubes connected to the tank



and extending in opposite directions therefrom, inclined hollow posts connecting the outer ends of each series of circulation tubes, a reservoir connected to the tubes for maintaining a reserve supply of water, means whereby an electric current is delivered to the electrodes, and means whereby electric current is delivered to any number of electrodes.

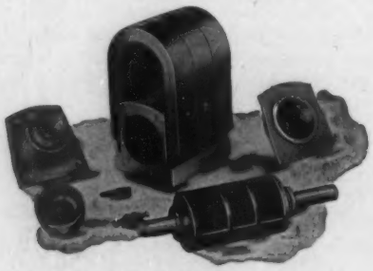
INDUSTRIAL

NEW LOW TENSION MAGNETO.

A marked increase in the use of magneto ignition has accompanied the growth of the automobile industry. The magneto is now considered an important factor in the equipment of not only high priced automobiles, but wherever improved and advanced devices are considered as essential and as adding to the worth of the machine itself.

The method of driving magnetos by gears or chains direct from the engine itself insures a supply of energy for ignition at correct and regular intervals. Reliability, ease of maintenance, simplicity, uniform quality and strength of spark, are all vital properties in any ignition system. The magneto is simple and eliminates complicated wiring, with the attendant dangers of short circuits and avoids the use of vibrating spark coils and batteries, which are always more or less troublesome and require much attention.

The General Electric Company has recently developed a magneto which embodies the most desirable features of construction as determined from its past experiences in other lines of work. This magneto is of the low tension type and



LOW TENSION MAGNETO

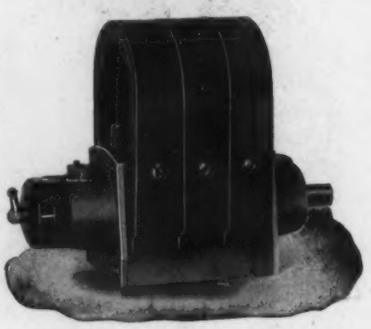
differs mechanically in many respects from other machines on the market at the present time. The general construction is most substantial and without superfluous trimmings.

Lubrication is effected by the use of waste packing in the same manner as has been successfully applied in connection with General Electric Company's automobile motors. Generous oil wells are provided with overflow holes to prevent excessive lubrication. The type of bearing used, eliminates the small wick oiling device heretofore so often used, and insures the ample lubrication necessary for these machines. The oil wells are readily accessible, and when covers are in place, are dust-proof and will operate for months without attention. Oil baffles are provided on both ends of the armature to prevent oil from working into the armature and interior parts of the magneto. Ample bearing surfaces are provided, as well as shaft of large diameter to insure strength, rigidity, and a minimum amount of wear.

Both the base and bearings are of bronze and finished with a sand blast which produces a very attractive appearance. Bronze has been found a more satisfactory metal than aluminum for this use, as it is less fragile, much more durable and looks cleaner after extended use. The general appearance of this magneto is shown in the accompanying illustrations.

A number of especially desirable features are noticeable in the construction of the armature. One end of the armature winding is brought out through the hollow shafting by means of a steel conductor. The insulation bushing between the shaft and this conductor is of bone, and is, therefore, little affected by moisture or light. The current is carried from the steel conductor by means of a phosphor bronze spiral spring to the lever nut which forms the outside terminal, thus avoiding any loose contacts. A hard rubber cover screwed to the bearing carries the contact with all its parts. This cover is provided with a knurled exterior. The grounded side of the armature winding is firmly fastened to the core, and a carbon brush insures good contact between armature winding and frame or ground.

The magnetos are of the double type, sprung on the frame and secured by one screw on each side, thus minimizing the detrimental effect of drilling the magnets. The long experience of the General Electric Company in producing millions of permanent magnets for meters and instruments has materially assisted in the production of permanent magnets for these magnetos. They are surpassed by no known product of this or any other country. The bearings being screwed to the top and base of the frame, rather than to the poles, results in minimum drilling of the pole pieces, thus further improving the properties of the magnets. The demagnetizing of the field magnets is prevented by avoiding a complete breakage of the permanent flux by making the armature core



NEW LOW TENSION MAGNETO

slightly overlap the pole gap when it is in a vertical position.

The skilled design of the armature allows generous insulation and also permits two other important advantages. With this magneto, an open circuit voltage of over 100 volts is easily obtained, while a short circuit current of approximately 0.4 of an ampere is available. In order to secure this high short circuit current, the resistance of the armature winding is as low as possible, while the number of turns is sufficiently high to give an adequate open circuit voltage.

The General Electric Company in introducing this magneto at this time, after the season's large volume of business is passed, is prepared to quote in quantities, with a view to entering this part of the electrical business extensively, during the next season. Samples of this new low tension magneto are being displayed at the various electrical and automobile exhibits this month and next in New York and vicinity.

Mathias Klein & Sons, 87 and 89 West Van Buren Street, Chicago, Ill., are manufacturing a new "Chicago Grip." It is made of steel throughout, and nickel plated, being a well-proportioned and thoroughly reliable tool. It is just the right shape to handle quickly, is light, and when placed on the wire will hold itself in place. It can be pushed out on the wire, so as to get as much slack as necessary, and it pulls straight, leaving no kinks in the wire. It covers all the essential points required of a grip to do good work on either iron or copper wire.

THE INVERTED GAS LIGHT.

By T. J. Litle, Jr.

If you should take an ordinary laboratory Bunsen tube and attempt to burn it in an inverted position, the chances are that you will experience great difficulty in making it burn properly, the tendency being for the flame to flash or fire back to the gas orifice in the base of the burner.

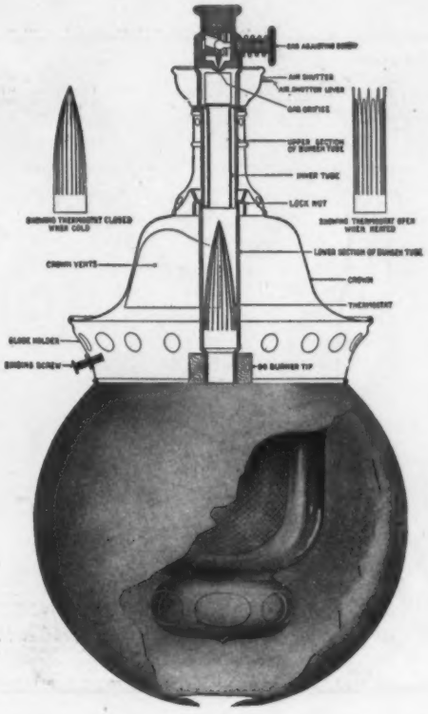


Fig. 1.

This is not surprising when we consider that illuminating gas is lighter than air, with a consequent tendency to act as a counter-force to the down-flowing mixture. For this reason a specially-designed Bunsen tube was produced after experimenting on the different conditions above mentioned in various parts of the country, and while this tube, or raceway, entrained sufficient air to produce a most excellent Bunsen flame, it did not overcome the difficulty of flashing back on lighting the burner.

Flashing back on the upright burners is prevented by the introduction of gauzes in the Bunsen tube as well as the burner cap. It was found, however, that the introduction of a gauze in an inverted burner was extremely detrimental to its working, particularly on low pressure, although it did effectively overcome the objectionable flashing back on lighting when the burner entrains more air than when after it is heated or during its normal burning, but it was the aim of the inventor to eliminate the gauze which he knew acted as an impedance to the flow, which, when coupled with the counter force produced by the lighter gas, caused carbonization, and also which he knew would collect or strain any dust which might be in the air entrained by the burner.

There is another way of preventing the flashing back on lighting, and that is to close partially the air shutter at the base of the Bunsen tube, but as the flame of the Bunsen changes, due to its inability to entrain so much air after being heated as when cold, it is obviously imperative that the air shutter should be open, and the burner entrain as much air as possible.

To obtain ideal working conditions, therefore, it would seem necessary either to insert a gauze on lighting the burner and afterward remove it when the burner became hot, or to partially close the air shutter on lighting and afterward open it.

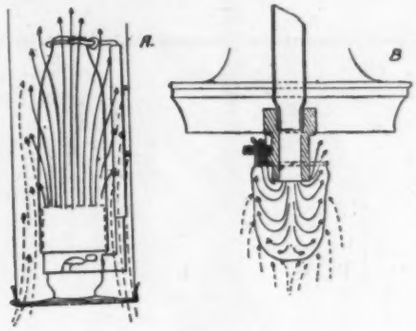
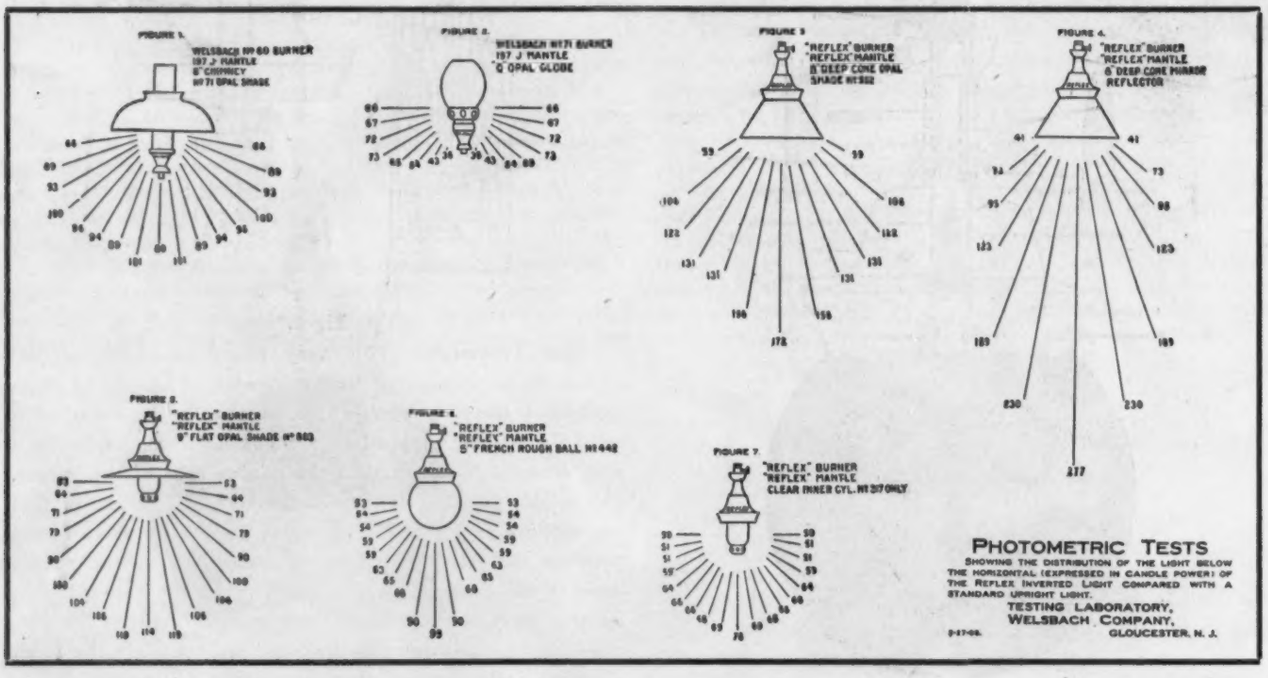


Fig 2.

The Thermostat—This very result has been accomplished in an extremely simple manner. A strip of thermostatical metal is stamped in somewhat the form of a comb; it is then wrapped over a conical form, producing a split cone. It is inserted in the mixing tube of the burner, and in this form performs the function of a gauze in that the mixture is compelled to pass through the narrow slits between the fingers, they being equivalent to the square mesh of the gauze. This is its form when the burner is first lighted; when the burner becomes heated, however, the narrow fingers straighten out and lie snugly against the inner surface of the mixing chamber, giving a free and unobstructed passage to the tube, with nothing to catch the particles of dust or lint, and at the same time compensating for the counter action caused by the heating of the Bunsen tube. At this point, I should like to state that the accumulation of dust in an incandescent gas burner has caused more trouble and been responsible for more unfavorable criti-

Fig. 3.

cism than any other one thing, as there are thousands of mantles in use giving indifferent illumination, due simply to the fact that they are being used on dirty burners. I have even known engineers to conduct endurance tests on a particular mantle without ever thinking of cleaning out the burner during the test, and the results obtained would appear to show an unusual deterioration, and so I repeat that the use of a thermostatic initial impedance in the place of the troublesome gauze will revolutionize gas lighting, not only by increasing the lighting efficiency, but also by the elimination of



that most troublesome feature—dust. It is needless to say that when the light is extinguished and the Bunsen tube cooled, the thermostat returns to its original position.

In attaching the mantle to the burner tip, it was found that the most convenient method was a bayonet lock, as this did not necessitate a close fit, which it is practically impossible to obtain with the materials used. The tip of the burner, which is subject to an extremely high temperature, in fact, a bright, cherry heat, had to be made of some infusible substance, the most suitable proving to be a magnesia clay, and it is obvious that the mantle ring must be made of the same substance. Metal tips have been used, but it has been found they quickly oxidize, scales dropping into the mantle and globe. Furthermore, the burnt growth on the inside of the tip clogs it, causing the burner to carbonize. Another problem to overcome was the discoloration of the fixture on which the burner was attached, due to the fact that the products of combustion were not properly diverted. The burner was so constructed as to send the products off to one side by means of heat deflectors over the crown vents, as shown in the cross-section cut, Fig. 1. Another advantage in deflecting the products of combustion off to one of the burners is that a fresh air supply for the Bunsen is at all times ensured.

The inverted mantle does not necessarily have to be removed from the tube before mounting on the burner, as does the upright mantle. It is simply necessary to remove the lid and raise the mantle and tube over the burner tip, turn and lock in the bayonet and remove the tube, leaving the mantle in position on the burner. The question naturally arises why an inverted gas light is more efficient than an upright light. By referring to Fig. 2, you will note the arrows indicating the flame paths and products of combustion; other arrows surmounting lines indicate the passage of the air currents around the mantle. Section A represents the currents in the upright mantle. The products of combustion are compelled to pass through the mantle, preventing the oxygen from the surrounding atmosphere from coming into intimate contact with the surface; whereas, in Section B you will note that the flame is baffled by the mantle so as to send the products out between the burner tip and the mantle ring, allowing free access for the oxygen and surrounding atmosphere to almost the entire surface of the mantle, thus ensuring a more perfect combustion at the surface, resulting in a much higher incandescence of a mantle, the more efficient the light, it being understood, of course, that the burner equipment remains the same.

As I have stated on several occasions, the mellow light mantle is in every way superior to a mantle giving a ghastly white light, and this is particularly the case with the inverted light, for the mellow light mantle is at its best when raised to a very high incandescence. The one great superiority of the inverted mantle over the upright, is its additional strength. The method of attaching to the holding ring is more favorable, and the dome-like shape of the mantle and its uniform suspension, is also superior. The inverted mantle has a smaller mass, consequently a lesser strain at the point of attachment. To bear out this statement, I might mention that inverted mantles have been in use in this country in railway trains for about two years, and several thousand coaches are

now so equipped, giving the greatest satisfaction. They are used with Pintsch gas, which has a calorific value of about 1,400 British thermal units, the pressure being one pound. The inverted burner consumes about thirty-three and one-third per cent less gas than the best upright burner, at the same time giving much more useful light. It is particularly adapted to reflection, as will be noted from the candlepower curves.

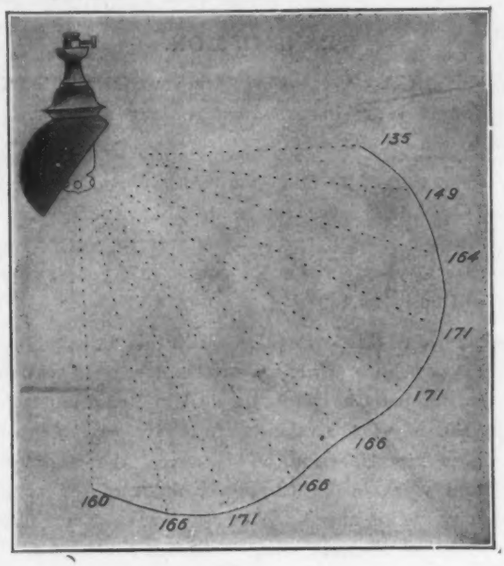


Fig. 4.

Lighting by electricity has received a great impetus in the last few years by the scientific application of prismatic glass reflectors, and while the same cannot be said of gas lighting, in connection with the upright mantle, it will be true in the case of the inverted light. A simple scheme for holding a Pagoda shade has been devised which, by proper installation, keeps the shade cool enough at all times to be handled. A concentrating Pagoda reflector is extremely useful in store-window lighting, etc., and incidentally shows the great lighting efficiency and economy to be obtained from the use of three cubic feet of gas, which at the prevailing average rate of $1.00 per thousand cubic feet throughout the country, would cost three-tenths of one per cent per hour.

Window Lighting.—Either one or two methods may be employed. In small windows one or two burners equipped with the angle reflector, as shown in Fig. 3, might be used, Fig. 4 showing the candlepower so obtained.

In large windows a row of these burners may be arranged high and to the front, and equipped with jump-spark electric igniters, so that they may be lighted from a distance, and the piping so arranged as to be automatically extinguished by clock work. Several installations of this kind are being successfully used in the larger cities.

Another successful means of lighting store windows is to arrange the burners with the proper reflectors, immediately above a deck of frosted glass. This allows the window to be completely sealed, and does not make it necessary to enter the windows to trim the lamps. The lamps may be lighted from a distance, as before mentioned.

Great progress has been made in Philadelphia and several other of the larger cities, in shop and factory lighting. The inverted light seems to be particularly adapted to this kind of work, and, as the mantle is very much stronger than the upright mantles, it will stand almost unlimited vibration, particularly when suspended on flexible metallic tubing. (See

Fig. 5.

Fig. 5, showing burner attached to the end of a flexible metallic gas-tight tubing.) This tubing is made by spirally winding a knurled-steel ribbon, at the same time enclosing an asbestos cord to make the joint. As there is no rubber used in the construction of this tube, it remains gas tight indefinitely, and should the burner be inadvertently struck, the burner would sway to one side, not damaging the mantle.

ALASKA-YUKON-PACIFIC EXPOSITION.

The management of the Alaska-Yukon-Pacific Exposition, determined to have everything finished and in working order by June 1, 1909, the opening day, is busily engaged on the work on the grounds. All of the grading will be finished by January 1, and several of the large buildings well under way. The Administration Building has been completed and occupied for several weeks.

The management is fully aware that the success of the Exposition depends upon its being ready on time, and intends to take advantage of every minute of the twenty months it has in which to have the Fair finished.

The Division of Exhibits and Privileges will soon be organized, and the work of arranging for displays and concessions inaugurated. It is the intention of the officials to start this part of their task far enough in advance so as to have all of the exhibit space allotted in time for the exhibitors to have complete installation on opening day.

WIRELESS TELEPHONES ON THE BATTLESHIPS.

Wireless telephones have been installed successfully on the battleships Louisiana and Virginia. With their aid, conversation can be carried on at a distance of five miles. All battleships are to be equipped with them, which may account cerning a new signal code.—"Sound Waves."

NEWS NOTES

ILLUMINATION.

San Luis Obispo.—The San Luis Obispo Gas & Electric Company's electric plant was destroyed by fire October 13th.

Fresno.—The City Trustees will receive bids up to November 18, for a light and power franchise as applied for by the Fresno Home Light and Power Company.

Azusa, Cal.—Mr. A. Ganslein, representing the Interstate Gas Company, of Los Angeles, is circulating a petition for a plant here to be located between Azusa and Glendora and supply both places.

San Bernardino.—Carl F. Schrader has filed a petition with the Board of Supervisors for a franchise for a gas and electric light system in Needles. He will obtain electric power from the Victor and Virgin Mining Company, and intends to put in a gas plant.

Alameda.—The Electricity Commission has opened the bids for the new engine to be installed at the municipal plant. The advertisement called for two kinds of bids, one for a cross compound and the other for a turbine engine. Numerous bids have been received for different grades of engines.

Los Angeles.—In the matter of the Compton Electric Light & Power Company, Gerald R. Fulton, general manager and secretary, who is an electrical engineer, resumed work on the plant, which has been abandoned by the contractors, E. Riverool & Co. Mr. Fulton states that the work will be rushed to completion.

Glendale.—The site has been obtained by the Southern California Gas Circuit Company for the proposed new gas plant. Directors of the company are Berchtold Baruch, president; Herman Cohn, first vice-president; James W. Hallman, second vice-president, and M. N. Newmark, treasurer; Samuel T. Mock, secretary and attorney.

Globe, Ariz.—The city has signed a contract with the Globe Electric Light & Gas Company for arc lights, and to pay rental on at least nine fire plugs. The company will put in an entire new plant for this service. The dynamo ordered has capacity for fifty lights and new poles will be put in and entire city wired for the arc system.

Los Angeles.—The presidency and control of the People's Gas and Coke Company and the right to use several valuable patents have become an issue in the courts, following a meeting of the directors, when Professor Thaddeus S. C. Lowe was deposed as president, and G. H. Hayes, of Goldfield, a mine operator, lessee of the Mohawk mine, was elected to fill his place. Hayes formerly was the vice-president of the company, which has under way extensive improvements and extensions of its service.

TRANSMISSION.

San Juan, Cal.—A corps of surveyors for the Stanislaus Power Company are in San Juan running a line from the Joaquin to the cement plant.

Oroville, Cal.—The Oro Water, Light and Power Company, of Oroville, has a crew of men at work in Humbug Valley, digging a ditch to convey water to a point on the Feather River, where, within the course of a couple of years, a plant will be installed.

Redding, Cal.—The Northern California Power Company will have 32,000 horsepower of electric energy in less than a year. The company has closed a deal in Red Bluff for 2,700 acres in the Manton section, particularly valuable for the water rights in connection. This means the beginning of construction work on a fifth power plant of the company. The capacity of this unit is to be 5,000 horsepower. The new plant will be on Battle Creek, five miles south of the twin power plants now in operation and located at Volta, near Shingletown. The company has a third plant in operation at Kilars, on Cow Creek. The fourth plant, the largest of all, is under construction on Battle Creek, at Horseshoe Bend. This plant will generate 16,000 horsepower, or as much as the other four combined. The dam for this plant is 110 feet high.

TELEPHONE AND TELEGRAPH.

Bakersfield, Cal.—The construction of a telephone line to the Weedpatch country is now practically assured. A meeting will be held soon to organize the company. The line, as planned, will be owned by those subscribing to it.

San Francisco.—Mamoru Tashiro and Merisaburo Tonegawa, officials of the Imperial Telephone Company of Japan, a corporation that has the backing of the Tokyo government, have arrived in this city from Vancouver, B. C. They are commissioned by their company to inspect the various telephone systems throughout the United States, with the object of utilizing whatever information they may gain in the perfection of the Japanese system. After an investigation of conditions here, which will be facilitated by the officials of the local telephone company, they will proceed to the cities of the East.

INCORPORATIONS.

Lakeport, Cal.—The Lake County Telephone and Telegraph Company has been incorporated. The directors are: H. S. Johnson, general manager of Pacific States for counties of Sonoma, Mendocino and Lake; A. H. Spurr, manager local exchange; L. J. Shuman, of Home Realty Company; Judge M. S. Sayre and F. L. Wright.

ILLUMINATION.

Colton, Cal.—Seth Hartley has secured a franchise from the City Trustees for installing a new gas plant.

Needles, Cal.—Carl F. Shader has made application to the Board of Supervisors for a franchise to install a gas system for Needles.

Los Angeles.—A brick building to contain gas generating equipment is to be erected at 812 Center Street by the Los Angeles Gas & Electric Company, to cost $13,000.

Pasadena.—The double-track franchise was awarded to the Pacific Electric Company, the only bidder, for $5000. The work must be completed within sixty days after it is begun.

Long Beach, Cal.—The Abestos Manufacturing Company has contracted for a prospect well, work on which will begin this week, to develop natural gas for commercial use.

San Diego.—The Council has adopted Ordinance 3029, granting a franchise to the Point Loma Electric Railway Company to construct and operate lines on certain streets in San Diego.

Glendale.—A bonus has been subscribed and right of way granted for an extension of the Los Angeles Pacific Railway from the Eagle Rock line to the center of Glendale. Work will begin the last of October and be completed in ninety days.

San Diego.—E. S. Babcock, president of the Los Angeles & San Diego Railway Company, states that the Cuyamaca road has secured an option on the electric car line which circles the water front. It is proposed to electricize the Cuyamaca road at some future time.

San Diego.—E. S. Babcock, president of the Los Angeles & San Diego Beach Railroad Company, announces that the proposition of extending the line from its present terminus in La Jolla to a site of the biological station is being considered by the directors of the company.

Ventura, Cal.—F. M. Packard and Julian Jones of Los Angeles, electric railroad promoters, have applied to the Board of Supervisors for a franchise for an electric line to the cement rock mines in the Matilija Canyon. They ask for a franchise through Ventura, along Oak Street to Metaa, to Ventura Avenue and the city limits.

Oakland, Cal.—A petition for a franchise for an electric road from the city limits to North Piedmont Heights has been filed with the Board of Supervisors by the Oakland Traction Company. The line of the proposed right of way, commencing at Grand Avenue, will pass east of the Country Club House. The district affected is a newly opened residence section, which will be given a decided impetus by the construction of the car line.

Riverside, Cal.—A franchise has been granted for the construction of a trolley wire from here to the new town of Crestmore, but owing to the expense of poles, etc., the Crescent City Railroad Company, which incorporated to build the road, will endeavor to have the franchise changed to allow the use of gasoline motor power to run the cars to the connection with the Main Street line. When the road is built it will be turned over to the Huntington, Riverside & Arlington Company as a branch.

Los Angeles.—In obtaining from the trustees of Wilmington a railway franchise to surround Wilmington Bay with a road, the Pacific Electric Company, backed by the Southern Pacific, has encountered a legal technicality in its franchise that makes the grant void. The franchise provides for the use of electric power, although the law states that only steam railroads can be given franchises without competitive bidding, and conforming to the law in other respects.

Prineville, Ore.—The city of Prineville is looking into the matter of construction of an electric railway to serve Prineville, Agency Plains, the Des Chutes Irrigation & Power Company, Redmond and Band. Leading citizens have investigated and find that $1,250,000 will build the line, and the city of Prineville will subscribe $150,000 toward this amount of stock if a syndicate can be formed. An effort will be made to ascertain how much can be secured from surrounding territory to be benefited.

Chico, Cal.—By a unanimous vote the Board of Trustees of this city has decided to grant to L. D. Macy, a local capitalist, a franchise to operate an electric light and heating plant in this city. This plant will be operated in opposition to John Martin's Chico Gas & Electric Company. Bids will be opened November 13th. Mr. Macy claims to have the backing of several San Francisco capitalists in the undertaking and is now there arranging with them for the immediate beginning of the work of construction. He owns water rights on Chico Creek near Water West branch, and it is here that the power house will be built.

San Francicso.—Plans for the power house to be erected at Fruitvale by the Southern Pacific Company show that it will be a low two-story, steel-frame, brick or concrete building, about thirty-five feet to the eaves. So far the electricizing only of the Alameda mole system, with its branches at Alameda and Fourteenth Street in Oakland, has been authorized and the necessary materials ordered. Eighty-five electric cars have been ordered. Forty-five of them will be motor cars, the plan being to have a combination baggage and smoking car with a motor section at each end of the train, and every other car in the train a passenger coach supplied with powerful motors connected with the motors on the terminal cars. The alternate passenger coaches will have the same appearance as the motor coaches. In appearance the new electric cars of this trolley service will be the same height and width as the standard size steam passenger coaches, but somewhat longer. The ordinary steam passenger coach now in use by the Southern Pacific seats sixty-four passengers, and the new electric cars will be long enough to have seats for eighty passengers. The power house on the estuary will be divided by a fireproof wall. On one side of this barrier will be two upright turbine engines, and opposite them on the other side of the wall will be two electrical generators. The generators will each be capable of maintaining a continuous current of 6000 horsepower, which they can for short heavy pulls increase to 10,000 horsepower each. It will be practically eighteen months before the new electric trains will supplant the Alameda-pier steam trains. No date or definite plans have yet been announced for the Oakland-mole electric lines with their branches to Oakland and Berkeley.

TELEPHONES.

Kent, Wash.—Kent Independent Telephone Company has been incorporated, capital $20,000; A. T. West, J. Howard Snively, C. E. West.

Bremerton, Wash.—The telephone and telegraph franchise was granted to W. B. Calder last week by the City Council. It is now up to the telephone people to "make good."

Valley, Wash.—H. L. Fisk has bought the Farmers' Telephone Line running from Springdale to Chewelah, and will make the central at Valley. He intends to go over the line and make quite an improvement. He will double the wire on most of the line.

Salem, Ore.—On condition that a fidelity bond in the sum of $2,000 be furnished for faithful performance of contract, the City Council granted the Northwestern Long Distance Telephone Company a franchise to operate a long-distance telephone service in this city for a period of twenty years.

Wallowa, Ore.—Six miles of poles are already set on the Government Telephone Line to Chico. Any person along this line may co-operate with the Government in the building of the line and enjoy free use of the phone or may pay a small monthly fee and install a phone without aiding in the building of the line.

Havre, Mont.—Work on the Havre-Box Elder Telephone Line will be commenced just as soon as the material can be placed upon the ground. There was a meeting of the business men interested in the project, in the office of Judge Meili, at which time Mr. Ward of the electric company of this city, made a bid of $100 per mile for the construction of the line, and he agreed to take one-quarter of the payment in stock of the company. This proposition has been virtually accepted.

Centralia, Wash.—A party of officials of the Northwestern Telephone Company was in town last week, composed of C. C. Craig, general manager; William Godfrey, of Portland, general superintendent, and Walter Hardinger, of Spokane, district superintendent. These gentlemen are on a tour of inspection of the new line and are making final arrangements for certain rights-of-way, so that gaps in the through system can be filled in as speedily as possible. They state that they expect to have the line in operation about December 1st.

North Yakima, Wash.—The telephone people have commenced to move to the new building opposite the Yakima theatre, and the public office is now located there. The building and the electrical devices inside are completed, and the only thing delaying the complete removal is the outside equipment. The laying of the cables is practically finished and the management expects to have the new equipment working within a short time. The installation of the new telephones will be a gradual process. There are 1,350 stations, and the change cannot be made in a day.

Hood River, Ore.—J. W. Gilkyson, division superintendent; W. D. Moore, division wire chief; A. L. Litty, division chief operator; Herbert Kerron, member of the construction department, were in the city looking over the Pacific States Telephone Company's properties. The company has plans for the immediate improvements in various departments of the local plant. The State Street lines are all to be cabled and a new switch board will be installed. Numerous improvements are under way which will conduce to the betterment of the service. Mr. Wright is now in the valley soliciting subscribers among the farmers.

Astoria, Ore.—Birch & Jacobson, the local contractors, are engaged in the erection of a wireless telegraph station on the crest of a hill in Astoria. The work has been contracted for by the United Wireless Telegraph Company, and will be ready for service during the latter part of this month. Mr. Birch, who is superintending the work, stated that the whole of this station will be 2,041 feet above the ground, and the contract included the construction of a small station house, which is now almost completed. It is possible that a similar station will be erected in Portland by Birch & Jacobson, for the same company in the near future.

Chehalis, Wash.—The City Council granted a twenty-five-year franchise to B. E. Clement for the installation of the Independent telephone system in Chehalis. The company will immediately begin construction work here, and intends to be operating by early next year. A very reasonable maximum phone rate was agreed on. It is proposed to install an up-to-date central-energy, copper-cable system. The city will also have permission to install a telephone fire-alarm system on the company's poles, which the company will operate. Already the company has the assurance of a large patronage in Chehalis, owing to the unsatisfactory service of the old company.

OIL.

Richmond, Cal.—Information has been authoritatively given out by the Standard Oil Company that it is going to increase the capacity of its plant here to double the present output.

Bakersfield.—According to report, another new refinery is in prospect for the Sunset fields. The company to enter upon this enterprise is the New Center Oil Company, which leases forty acres of land in the Sunset fields. The company is composed of San Francisco men, with Charles A. Son at the head of their financial operations. Mr. Reynolds is field superintendent. Mr. Reynolds is authority for the statement that work will be commenced soon on the up-to-date plant.

Los Angeles.—Painting the name of the Associated Oil Company over that of the Southern Pacific on 300 new oil-tank cars, which began last week, blots out the last hope entertained by the independents for increased shipping facilities for their oil during the coming winter. The Associated will use them all in its Southern California fields and the evidence of transfer by the railroad is now conclusive. Smaller shippers are already avoiding making many contracts for fear of inability to deliver, and the prediction is that the year will see a greater shortage than ever before, despite the announcements to the contrary when the Southern Pacific's new cars came in. Failure to distribute them impartially gives the Associated practical control of the railroad company's shipping facilities. The only ray of hope remaining is that the Santa Fe will place 500 new cars in service. Part of these are already here. Officials state they will be sent to the fields where the greatest demand for transportation warrants.

POWER AND LIGHT.

Vancouver, Wash.—Proposals will be received by Chief Quartermaster, Vancouver Barracks, Washington, until 11 a. m. of October 24, for furnishing and installing electric-light fixtures in the new N. C. O. quarters, railroad station and postoffice at Fort Stevens, Ore.

Thompson, Mont.—The company which owns and operates a power plant here has put a crew of men to work on the right of way for a high-power line to Murray, the principal town on the north side of the Coeur d'Alene district. Connections will soon be made, and the Murray mines will use electric power, which will greatly assist in their development.

Spokane, Wash.—That the Idora Mine will be furnished with electric power within a few weeks, is the ambition of local directors of the company. A movement is on foot to install a compressor and other necessary machinery at the mine, and to arrange with the Washington Water Power Co. for an extension of the power lines from the Hercules Mine, less than two miles away, to the Idora workings.

Salem, Ore.—The contract has been closed and signed for the installation of a modern coal-gas plant, equipped with a regenerative bench, to take the place of the old plant of the Portland General Electric Co. in this city. The cost of the improvements in contemplation will approximate $15,000, and when completed will give Salem one of the best gas manufacturing plants in the Northwest, and will increase the capacity of the present plant, which will be held in reserve, fully three times. The contract was let to the Western Gas Construction Co., of Fort Wayne, Indiana, and construction will be commenced as soon as possible.

Lewiston, Ida.—Surveyor W. C. McNutt and John Massam are negotiating with Eastern parties for the sale of the power site they located on the Selwai last Spring, and it is probable the deal will be closed within a few days. The site is twenty-four miles from Elk City, at a fall where the river is wide, and Surveyor McNutt estimates the number of horsepower will not fall below 20,000 at any season of the year. It is said the buyers of the site intend to put in an electric plant, and will furnish power for Elk City business houses and for mines in the district. There is a theory also that the men who are buying the power site are in close touch with two of the railway companies that now have surveying crews along the Selwai, and this being true, it is the strongest indication that could be shown that the Selwai and Middle Fork country stand a good show of getting a railroad before long.

TRANSMISSION.

to L. D. McMacy a franchise to operate an electric light and heating plant in this city. Bids will be opened November 12th.

Santa Rosa, Cal.—The Board of Supervisors will receive bids up to November 9, 1907, for the power line franchise applied for by the Snow Mountain Power Company.

Chico, Cal.—The Board of Trustees has decided to grant

Carson, Nev.—R. F. Condit, representing the Nevada Machine Supply Company, of San Francisco, has been in this city, but has left to make the surveys for a power plant to be built for a new plaster quarry that is to be operated by Reno men between Dayton and Mound House. This Company will build a big plant for the refining of a chalk deposit.

FINANCIAL.

San Francisco.—A dividend of 1 cent per share, payable November 15th, has been announced by the Claremont Oil Company.

San Luis Obispo.—An annual meeting of stockholders of the Santa Lucia Oil Company will be held October 29th.

San Francisco.—A mortgage deed has been placed on record, whereby the Central California Power Company deeds its water and land rights, also its plant, in trust to the California Safe Deposit and Trust Company to secure the latter corporation in guaranteeing an issue of $5,000,000 worth of 5 per cent thirty-year bonds.

Los Angeles.—Details have been completed for the sale of the $1,050,000 Los Angeles aqueduct bonds, and the Council will meet in an adjourned session to take official action on disposal of the first issue. One-half of the issue is to go to the State, the money coming from the sale of State lands, the other half has been subscribed by local banking corporations. The Council will advertise for bids for the first issue. The bonds bear 4 per cent interest, and the last series is redeemable in 1947. A second issue of the bonds for the same amount will be made about December 1st.

San Francisco.—Suit has been brought by the Lagunitas Water Company against the Marin Power and Water Company of Marin County, for an injunction to prevent the employes of the defendant corporations from trespassing on the Berri ranch. This is owned by the Lagunitas Company and is located on the northwest slope of Mount Tamalpais. The Lagunitas Company owns land of the Howard-Shafter estate in Marin County, and the Marin companies get a supply of 200,000 gallons a day from these lands. There has been a fued between the two companies for more than two years.

INCORPORATIONS.

Fresno, Cal.—The Premier Oil Company has been incorporated by W. M. Wallace, C. J. Berry, Timothy and P. E. Spellacy of Los Angeles and J. D. Thomson of Pasadena. Capital stock is $1,000,000.

Pasadena, Cal.—The Seaboard Construction Company has been incorporated, with a capital stock of $50,000, to operate gas, ice, electric power plants and pipe lines. J. S. Noyes, H. G. Simpson, Elmer I. Moody and C. M. Simpson are the directors.

Los Angeles.—Articles of incorporation have been filed by the West Chino Water Company, with a capital stock of $20,000, by Ralph Bandini, J. P. Loeb and W. S. White.

Hanford, Cal.—The Crow Oil Company has been incorporated with a capital stock of $400,000, by J. T. and C. C. Crow, R. B. Marshall and others.

San Francisco.—Articles of incorporation of the San Juan-Pacific Railway Company have been filed. The purpose of the company is to build a railway from Hollister, in San Benito County, to Watsonville, in Santa Cruz County, via San Juan and Chittenden, with branches. The line will be thirty miles long. The company is capitalized at $1,500,000, divided into 15,000 shares. The names of the directors are: Frank C. Brown, San Francisco; Charles F. Ladd, Portland; Gustav Baumann, H. P. Wilson, New York; V. Enginger, San Francisco; H. C. Stratton, San Francisco, Jesse W. Lilienthal, San Francisco.

TRANSMISSION.

San Francisco.—The strike of the electrical workers, which was inaugurated a few days ago against all the corporations controlled by the Fleishhacker interests in California and Nevada, has terminated by agreement and the men have returned to work.

San Bernardino.—Henry L. Green, who states his address is 427 South Olive Street, Los Angeles, is posting notices and recording same on water rights in the Waterman Canyon. It is believed that Mr. Green is acting in the interest of the Arrowhead Reservoir & Power Company for electrical purposes.

Marysville, Cal.—Notwithstanding the amount of business piled up around them, the Southern Pacific Company will soon have six hundred carloads of Eastern freight passed up to them at this point to be diverted. It is the large consignment of electrical machinery for the Western Power Company and the Utah Construction Company, which latter company will install it for the first named. The cars will be delivered to the Western Pacific Company on the curve at Ninth and K Streets and be hauled via Oroville over Western Pacific tracks to Big Bend in the Feather River canyon.

Santa Rosa.—The Snow Mountain Water & Power Company, which has constructed reservoirs in the vicinity of Ukiah, has petitioned for twenty-five additional lines through Sonoma County. The petition presented to the Board of Supervisors is in addition to the franchise recently granted to Frank M. Burris for the same company. The company has already been granted permission to construct power lines to the principal cities of the county, and the poles are already being placed for these. The twenty-five additional lines asked for will be feeders from these various main wires. Among the places to be touched by these wires will be Sebastopol, Fulton, the Todd District, Guerneville, and all the country adjacent thereto, Sonoma, Windsor, Occidental, Mollino, Duncan's Mills, Bodega, Corners, Bloomfield, Valley Ford, Two Rocks, Penngrove, Denman's Station, Tomales, Marin County and other places.

WATERWORKS.

Oakland.—Plans for a salt water system, furnishing auxiliary fire protection to the city, to cost in the neighborhood of $130,000, have been adopted by the Board of Public Works. The unique features of the scheme are the utilization of the main lake sewer and the extension of mains to the water front, where fire tugs can couple on and lend their force to provide additional pressure in case of a great conflagration. The use of the main lake sewer is considered an important innovation. The sewer is 5½ feet in diameter and extends from Lake Merritt to the bay. This will be used as a reservoir of salt water, the flow of water being shut off by automatic gates when necessary. A pumping station is to be built on the shore at the "Willows," and from this point mains will be run throughout the business section of the city and down to the water front, where plugs will be provided for use in conjunction with the fire tugs. The mains about the city are 12- and 14-inch, with 8-inch laterals. City Engineer Turner believes that the use of the main-lake sewer will obviate the necessity of cleaning it once every two years, as has hitherto been the custom. This has cost the city on an average of $1500 each time. The total cost of the plant will be $72,000 for the pipe system alone, $48,000 for the pumping plant and its machinery, and $10,000 for the building for the pumping plant. The Merchants' Exchange has discussed the establishment of salt water street sprinkling and fire protection plants, and it was decided to support the plan which has met with the favor of the City Council.

CLASSIFIED LIST OF ADVERTISERS

Air Compressors
Hunt, Mirk & Co.

Alternators
California Electrical Works

Aluminum Electrical Conductors
Pierson Roeding & Co.

Annunciators
California Electrical Works.
Century-Klein Electric Co.
Holtzer-Cabot Elec. Co.
Patrick, Carter & Wilkins Co
Tel. and Elec. Equipment Co.

Asbestos Products
Johns-Manville Co., H. W.

Batteries, Primary
California Electrical Works
Standard Electrical Works

Batteries, Storage
Western Electric Co.
Century-Klein Electric Co.
Electric Storage Battery Co.
Tel and Elec. Equipment Co.

Boilers
Moore, C. C. & Co., Inc.
Risdon Iron Works
Standard Electric Works
Tracy Engineering Co.
Hunt, Mirk & Co.

Boiler Compounds
Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.

Buffers
Northern Electrical Mfg. Co.

Building Material
Johns-Manville Co., H. W.

Building Paper
Johns-Manville Co., H. W.

Circuit Breakers
Fort Wayne Electric Works
Century-Klein Electric Co.

Condensers
O. C. Goeriz & Co.
Moore, Chas. C. Co., Inc.
C. H. Wheeler Mfg. Co.

Conduits
American Circular Loom Co.
American Conduit & Mfg. Co.
Tel. and Elec. Equipment Co.
Century-Klein Electric Co.

Conduit Fixtures
American Conduit & Mfg. Co.
Century-Klein Electric Co.
Tel. and Elec. Equipment Co.

Cooling Towers
O. C. Goeriz & Co.
Moore, Chas. C. Co., Inc.
Tracy Engineering Co.

Cross Arms
Century-Klein Electric Co.
Tel. and Elec. Equipment Co.
California Pole & Piling Co

Dynamos and Motors
Brooks-Follis Elec. Corp.
California Electrical Works
Century-Klein Electric Co.
Fort Wayne Electric Works
General Electric Co.
Holtzer-Cabot Elec. Co.
Northern Elec. Mfg. Co.
Standard Electrical Works
Tel. and Elec. Equipment Co.
Westinghouse Elec. & Mfg. Co
Wagner Elec. Mfg. Co.

Elevators
Van Emon Elevator Co.

Electric Car Heaters
Johns-Manville Co., H. W.
Northern Electrical Mfg. Co.

Electric Grinders
California Electrical Works
Northern Electrical Mfg. Co.
Tel. and Elec. Equipment Co.

Electric Heating Devices
Johns-Manville Co., H. W.

Electrical Instruments
Cutter Co., The
Century-Klein Electric Co.
Fort Wayne Electric Works
General Electric Co.
Johns-Manville Co., H. W.
Tel. and Elec. Equipment Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Instrument Co.

Electrical Machinery
California Electrical Works
Northern Electrical Mfg. Co.
Standard Electrical Works
Century-Klein Electric Co.

Electric Polishers
Northern Electric Mfg. Co.

Electric Railway Appliances
Pierson, Roeding & Co.
Johns-Manville Co., H. W.

Electrical Supplies
California Electrical Works
Century-Klein Electric Co.
Standard Electrical Works
Johns-Manville Co., H. W.
Tel. and Elec. Equipment Co

Electric Ventilating Fans
Century-Klein Electric Co.
California Electrical Works
Northern Electrical Mfg. Co.

Engines, Boilers, Heaters, etc.
Moore, Chas. C. Co., Inc.

Electric Watchman's Clocks
Tel. and Elec. Equipment Co

Engineers, Chemical
Smith, Emery & Co.
Moore & Co., Chas. C., Inc.

Engineers, Electrical
Standard Elec. Works
Tracy Engineering Co.
Westinghouse Machine Co
Hunt, Mirk & Co.

Engines, Gas and Gasoline
Moore & Co., Chas. C., Inc.
Westinghouse Machine Co
Hunt, Mirk & Co.

Engineers and Contractors
Brooks-Follis Elec. Corporat'n
Byllesby & Co., H. M.
California Electrical Works
Cannon, Edward F.
Hunt, Mirk & Co.
Century-Klein Co.
Copeland, Clem A.
Doble Co., Abner
Doble, Robert McF.
Cory, C. L.
General Electric Co.
Hunt, Dillman, Meredith & Allen
Jackson, D. C. & W.
Smith, Emery & Co.